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TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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A. S. M'ALLISTER.....Associate Editor
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FLAT RATE RESIDENCE LIGHTING.

We have several times referred to the interesting experiment being carried on in Hartford, Conn., with a flat rate applied to low-voltage tungsten lamps for the purpose of solving the difficult problem of economical residence lighting. The general method followed in that city has been to supply through auto-transformers, tungsten lamps of about one-half the ordinary voltage, working them at slightly less efficiency, about 1.35 watts per candle, than the standard lamps in order to secure great length of life. At the present time there are some 15,000 such lamps in operation in Hartford, the standard size being the 15-watt lamp. The life of the lamps thus used is set to approximate 2000 hours and the low voltage insures a filament which is suitable enough to free it from most of the exigencies of accidental breakage. The flat rate on the minimum basis is extended to residences only, commercial lights being on another schedule. The base rate is 10 cents each per lamp per month for the first 10 lamps and 6 cents a month for each additional lamp for the size mentioned. As this is coupled with a very modest charge for the first installation of lamps and a really nominal one for renewals, the cost for lighting per month under this schedule is brought to an exceedingly low figure. On the other hand, the station is relieved of everything pertaining to the purchase and installation and care and reading of the meters, and the bookkeeping is, of course, greatly simplified. The lighting company has always gone into pushing its business by doing installation work at a very moderate figure, with the result that this class of business is increasing very rapidly. Some precaution against overloading the circuits, as by putting on larger lamps, is afforded by automatic cut-outs. It is furthermore understood that the actual working out of the output under this scheme leads to a fairly good price for current.

Indeed, it is easy to see that if the base rate per unit were in the vicinity of 10 cents, the lamps installed would have to average a good two hours daily burning in order to bring the price to the consumer down to the base for installations not exceeding 10 lamps. With a greater number of lamps, on which the average rate would be lower, there is less likelihood of reaching such a figure of burning, so that the supply company does not stand to lose unless the consumers really go out of their way to abuse their privilege, which generally they are not disposed to do. It is very interesting to see this reversion to early methods appearing, particularly with the advent of the highly economical lamps that have caused alarm to some central-station managers. The auto-transformers employed on the system seem to give very little trouble and have very small constant losses. One might naturally apprehend some trouble with the regulation if the load of this character should become really a considerable part of the output. Residence lighting is very rarely a large factor in output, and inasmuch as its peak falls later than the general peak, any trouble that it might pro-

duce is minimized. The flat-rate method of charging is very generally considered as illogical in that it does not charge the consumer for just what he uses, but for what on the average he is likely to use. The considerations that lead to employing flat rate are practical rather than theoretical and their net result can only be told after considerably wider experience than is given by a single skillfully handled station in a conspicuously prosperous community. The scheme, however, is a most interesting one to those who find it difficult to develop residence lighting along the usual lines and the further expansion will be watched with the greatest interest by central-station managers. It is most sincerely to be hoped that this or some other method will be developed to remove the reproach that less than 10 per cent of the homes in central-station towns and cities of this country use the electric light. Unfortunately, this situation appears to have been accepted as inevitable, just as, in earlier days, central-station men were almost unanimous in considering that "there is no money" in carrying a motor load.

AMPLITUDE AND WAVE FORM OF THE LEAKAGE CURRENT IN A MERCURY-ARC RECTIFIER.

The mercury-arc rectifier is one of the most wonderful of electric devices. When connected and started in the proper direction, in a direct-current circuit, it may allow, say, 30 amp to flow steadily through the arc with a pressure drop of 20 volts. If, however, the direction of the e.m.f. in the circuit be reversed, the tube will act as an insulating barrier, and will shut off the current, unless the voltage at the rectifier terminals becomes enormously great. It is a wonderful sight to see one of these rectifiers supplying a 10-kilovolt, direct-current arc-circuit from a single-phase, alternating-current system. The device rectifies 120-current impulses in each second of time, without any apparent effort, owing to the great speed with which gas molecules, or atoms, are able to move in a highly exhausted tube. When it is said that no current passes through the tube in the reverse direction, it is meant that the strength of such reversed or leakage current is practically zero, because there is, in fact, a very minute leakage of current through the device in the reverse direction. This leakage tends not only to increase the temperature of the apparatus, but also to lower its effectiveness and efficiency.

An important communication by Mr. G. Schulze on this leakage current is referred to in the Digest, from researches made at the Reichsanstalt. It appears that the leakage current is ordinarily only a few microamperes when a rectifier is started cool on the ordinary low-tension load. As the device warms up, however, the leakage current increases, so that after 10 or 15 minutes it may increase to over 100 microamperes. Its final magnitude depends on the voltage, the delivered current, as well as on the nature and construction of the tube. Long, narrow anode arms tend to reduce the leakage current, while short, wide anode arms tend to increase it. Much depends also on the surface and working temperature of the anodes. A remarkable circumstance is that when the rectifier supplies a given current strength to charge a storage battery, the leakage current is somewhat greater than when it supplies that current to incandescent lamps, apparently for the reason that, in the latter case, the back voltage drops between successive current impulses; whereas, in the former case, the storage battery keeps the back pressure nearly constant at all parts of the cycle. The importance of a study of the leakage current lies in the fact that as soon as this leakage exceeds a certain critical value, the device fails to rectify and breaks down in a steady arc that may speedily destroy the apparatus. Consequently, whatever tends to lower the leakage current, tends to increase the possible output, or, for a given output, the margin of stability.

A SIMPLE DIAGRAM FOR THE DROP OF PRESSURE IN TRANSFORMERS.

It is well known that a transformer behaves substantially like a simple choking coil, after change of voltage has been taken into account. That is, if we reckon the secondary circuit as receiving the same amount of power at primary pressure, the transformer acts like a simple choking coil connecting the primary and secondary circuits. Or, again, if the transformer be replaced by a level transformer of the same capacity, this equivalent level transformer would inductively link the equivalent level secondary circuit with the primary circuit, in essentially the same manner as a simple choking coil would link them conductively. In fact, if we ignore the exciting current in the transformer, the proposition is rigidly correct. Consequently, at all but very light loads the percentage drop of pressure in a transformer, taking both primary and secondary windings into account, is the same as would occur if the same volt-ampere load were taken direct from the primary mains through an equivalent choking coil of definitely assignable resistance and reactance.

As noted in the Digest this week, an article has recently appeared in the *Elektrotechnische Zeitschrift*, by Mr. J. A. Shouten, in which certain geometrical results are deduced. It is shown that for each transformer there is at any given load, say, rated load, a certain circle, the diameter of which measures the maximum percentage drop of pressure that can be produced in the transformer with the most unfavorable power-factor of load. A certain chord of the same circle represents the percentage drop at 100 per cent power-factor, and as the power-factor of the load is reduced, the chord increases or moves along the circle to the diametrical position. A simple diagram of straight lines, constructed for the particular transformer, will, therefore, enable the drop of pressure to be obtained by inspection for any given secondary load and power-factor. This diagram is not only easy to prepare, when the necessary electrical data concerning the transformer are available, but it may also be used and interpreted by any reader without the aid of technical skill or mathematical knowledge.

GERMAN EXPERIENCE WITH LOADED AERIAL TELEPHONE LINES.

As noted in the Digest, a recent paper by Mr. A. Ebeling before the Elektrotechnischer Verein describes the results which have been practically obtained by the German telephone administration with the Pupin system of loaded aerial telephone lines. It will be remembered that, in this system, choking coils are inserted at intervals of a few miles along the telephone line. By this means the total reactance and impedance of the circuit are markedly increased and the telephone current strength in the circuit correspondingly reduced, with a like reduction in thermal waste, so that the telephone current carries further or enables the range of communication to be increased. In Germany they place the choking coils, or load coils, in sealed pots mounted on a porcelain insulator of a telegraph-pole cross-arm. Each such

pot-coil requires to be shunted by a knob lightning arrester, carried on an adjoining porcelain insulator. A steel bracket with two insulators, one for the pot-coil and the other for the lightning arrester, forms a pole-unit for insertion at intervals of, say, 8 km. The conclusion reached in the report is that, from practical experience, a 3-mm loaded overhead line circuit is the equivalent of a 4.5-mm unloaded line circuit. On this basis alone an economy in the line conductor of roughly 50 per cent is made out in favor of loaded lines. But this is only part of the advantage. All telephone lines have to go underground in large cities, and each mile of underground line of the ordinary size is the equivalent of, say, 30 miles of ordinary overhead line. Consequently, a few miles of city cabling suffices to cut down the range of transmission very materially. The insertion of loading coils in the underground lines helps to undo the effect of the cabling, and thus renders long-distance telephony once more possible, where otherwise it would be commercially impossible.

RESISTANCE THERMOMETRY AT HIGH TEMPERATURES.

The measurement of temperature is one of the most important physical measurements we possess, and one of the most widely used. Thermometers are almost as widely known and used as foot-rules. But whereas foot-rules, of some kind, are of great antiquity, and certainly antedate the Egyptian pyramids, thermometers are relatively modern instruments, and were invented about the year 1610, based on the expansion of mercury contained in a glass tube. The practical development of the thermometer necessitated the adoption of a temperature-scale, and thereby hangs a tale of woe. England adopted the scale introduced by Fahrenheit, a German then living in London, who selected the freezing and boiling points of water as reference points, divided the intervening interval into 180 degrees—half the sacred number of angular degrees in a circle—and then took as zero the temperature reached one severely cold winter day in London, 32 of these degrees below the water-freezing point. Except that the Fahrenheit degree is of convenient magnitude in everyday affairs, and that relatively few daily temperatures are negative on this scale within the temperate zones, the Fahrenheit scale is as clumsy and unscientific as it could well be. It exists only by reason of psychological inertia. The Centigrade scale employs the same reference points as above, namely, the freezing and boiling points of water under standard atmospheric pressure; but divides the intervening interval into 100 degrees, and takes the freezing point as zero. This is a reasonable and technically satisfactory scale in the ordinary affairs of life, and much to be preferred to the Fahrenheit scale.

Investigation into the habits and affairs of gases, such as hydrogen, nitrogen and air, led physicists to define another scale of temperature, or the gas-thermometer scale. Its reference points are the freezing and boiling points of water, as before; and the intervening interval is divided into 100 degrees, as in the Centigrade scale; but instead of taking the water-freezing point as zero, like the French scientists, or as 32 degrees, like Fahrenheit on this cold wintry day, it is taken as approximately 273 degrees on the gas-thermometer absolute scale. The reason for this selection is that reckoning back from the expansion of gases at ordinary temperatures, they would reach zero volume at this absolute zero. This scale then begins at the inferred beginning of gas volume, and reaches the water-freezing point after 273 degrees have been passed. The absolute scale is a much more comprehensive and fundamental scale than the Centigrade scale. The latter exaggerates the importance of the freezing point of water in the existing order of things. Owing to the slight deviation of gases from the law of Charles, that their volumes under constant pressures are proportional to their absolute temperatures, the gas-thermometer absolute temperature is not quite the same as would be found if the gas were the ideally perfect fluid, strictly obeying Charles' law. The corresponding scale of a perfect gas is a theoretical scale only, and is sometimes called the thermodynamic scale, fortunately differing only very slightly from the gas-thermometer absolute scale. All of the above-mentioned scales may be considered as scales defined by the expansion of material with increase of temperature, or as connected with the thermomechanical properties of matter. In addition, there are two thermo-electrical properties of matter by which temperatures may be compared. One of these is the thermoelectric e.m.f. of bimetallic junctions, and the other is the increase in the resistivity of metals with increase of temperature. The latter property gives us the copper-thermometer for low and moderate temperatures, and the platinum-thermometer for low and high temperatures. The electric platinum thermometer was invented by Sir W. Siemens in 1871. Its scale is usually graduated to conform as nearly as possible to that of the gas-thermometer, by extrapolation from the resistances observed at reference temperatures.

A recent paper by Messrs. Waidner and Burgess, in the *Bulletin* of the Bureau of Standards, on the platinum thermometer, contains a large collection of facts and observations, as well as a copious bibliography of this important subject. The resistivity of commercially pure platinum follows approximately a straight-line law of increase with temperature, and such that it points to an absolute zero of resistivity at about —257 deg. C. or + 16 deg. Abs; whereas the copper thermometer is known by other researches to indicate from the straight line law at ordinary temperatures a corresponding zero resistivity at —235 deg. C., or + 30 deg. Abs. Minute impurities in the platinum materially affect the straight-line law of resistivity, and it seems likely that even gases occluded in the metal affect its resistivity behavior. Consequently, each particular platinum-resistance thermometer requires to be standardized, both as to the inclination of its straight-line resistivity law, and also as to the extent of deviation from this law at high temperatures. Nevertheless, the paper shows that, with careful observers, the precision attainable in the measurement of high temperatures by means of the platinum thermometer is almost equal to that attainable by means of the gas thermometer. A number of freezing-point temperatures are recorded in the paper, obtained with the platinum thermometer as compared with corresponding values obtained by other means. These appear to agree remarkably closely, considering the manipulative difficulties involved. In particular, the melting point of pure silver at 961 deg. C. is described as being sharply defined and readily reproduced. For further details, the original paper must be consulted, which forms a valuable addition to the literature of the subject.

ANOTHER NOVELTY IN ARC LAMPS.

A paper by Wedding in a recent issue of *Electrotechnische Zeitschrift*, and abstracted in the Digest, gives an account well worth reading of a novel flame lamp. Singular from the remarkable position of its carbons and its almost complete lack of anything that can be called mechanism, the carbons, which may consist of a single pair, two pairs or a magazine device when long burning is necessary, lie horizontally one close over the other, the negative beneath. The pair forms something very like the old Jamin candle, the light being kept in place by the electromagnetic field between the carbons in their horizontal position. The upper carbon burns away obliquely and turns its crater downward, the negative burning to a roundish point. With the carbons of oval section and proper size, the burning goes forward very smoothly and gives an admirable downward distribution of light with a life of 8 or 10 hours per pair. With the addition of suitable cut-out arrangements and with revolving carbon holders, it is proposed to burn as many as 16 pairs of carbons, so that the lamp may be able to run 72 hours between trims. The distribution of light is at a maximum about 40 deg. below the horizontal, and obviously varies in its horizontal distribution according as the arc is more or less shielded by the carbons, the distribution being helped out, however, by a reflecting surface overhead. The lamp is both simple and curious in design and results in a structure about 20 in. in diameter and 12 in. deep, the bottom being a shallow bowl. There are many ingenious points about the arrangement in which those interested should turn to the original paper, but the construction marks a very radical and interesting departure from the lamps now in common use. The efficiency of this, as of all lamps of the yellow flame carbons, is high, running down to near ¼ watt per candle with respect to the energy at the arc. Just what progress such a novelty will make depends, of course, on many things besides its theoretical interest. The weak point of most flame arcs is the short time of burning, associated, thanks to our present tariff, with an enormously high cost of electrodes. The proposal to use a repeating lamp with a considerable number of carbons is an old one and has thus far not proved very satisfactory; whether the problem can be worked out in the structure here indicated so as to secure a successful lamp of this type is a matter of some question, although the extreme simplicity of the mechanism stands in its favor.

A WINNING CENTRAL-STATION POLICY.

No consumer present or prospective likes to think that he is at the absolute mercy of a company which has a monopoly of electric service. Regulated monopoly is correct in theory, but the less the average consumer is reminded of it the better, especially at times when he has a real or fancied grievance regarding the service or the treatment he is given by the public service company. Several managers who have been notably successful in winning the favor of the public in their respective communities and in securing rapid increase of business, have named as one of the principal secrets of their success the fact that they never treat the public as if they have a monopoly of the business. As one manager puts it: "I act as if there were six other electric lighting companies doing business in the same town and anxious to get the consumer's business." He might have added that as a matter of fact there are numerous competitive illuminants which may be as damaging as a competitive electric lighting company, if the management does not assume the proper attitude with the public and require his employees to do the same. The constant attitude of mind possessed by the manager who never allows himself to say anything indicating the monopolistic features of his service is one of the most valuable assets he can possess for getting along well with the public. Anyone well acquainted with the course of the central-station industry can doubtless cite many cases where the establishment of competing or municipal plants has been solely due to the high-and-mighty airs displayed by those representing the original company before the public in virtue of their assumed superior non-competitive status.

NEW-BUSINESS PROMOTION AND GOING VALUE.

Is money spent in procuring business to rapidly put a central-station company on a paying basis justly chargeable to capital account—that is, to the true cost or value of the plant? This question is one of vital interest to the numerous managers who are to-day engaged in taking over run-down or neglected central-station properties and turning them into paying properties. It has been a number of times discussed, and was brought up at the Wisconsin Electrical Association convention by Mr. Harold Almert in connection with a discussion on the going or running value of an electric light and power company's property as compared with its purely physical value. There is naturally much interest among Wisconsin companies as to the attitude which the Public Service Commission of that State will take on this question. Mr. Almert in his remarks put the question at issue in its clearest form. He took, for illustration, two hypothetical companies, both of which are at the beginning on an unprofitable basis. One company he assumed to be conducted after the manner in which many companies have been conducted in the past, namely, allowing business to come to the company slowly without much effort on the part of the management, until after a long time the gross receipts are sufficient to exceed the operating expenses by an amount adequate to pay interest, depreciation and dividends. In the case of the other company he assumed that active efforts were put forth to build up the business to a profitable state in a short time. Two interesting points were then raised, one being whether the net deficits of the first company for the years it is operated at a loss are to be charged against the cost of the property as a going concern. The other is whether the money spent in new-business promotion to bring the other up to a profitable state in a short time is to be charged against the cost of the property as a going concern.

It might be argued that the lack of foresight which would allow money to be put into an enterprise that would be operated for a number of years at a loss should deprive the investor of grounds for charging against the cost of the property this deficit. On the other hand, however, the investor may have gone into the enterprise with the expectation that it would be operated at a loss for the first few years, and with anticipation of unusual profits after the first few years of deficit. Certainly no other assumption would be fair to the investor within reasonable limits. As to the question of charging new-business promotion during the early stages of an enterprise to capital account, commissions will probably be

inclined to go slowly in allowing such charges. Nevertheless, if the results attained justify the expenditure, it would certainly seem that such charges should be allowed. If we were to suppose, for example, that the operating and owning company were to make a contract with a second party for the construction of a central station and for the turning over of the property and business in a profitable operating condition, no question could be raised if the contractor should ask a price covering the expense of the promotion of new business after the plant had started in operation. In many cases the investment required for this would be less than for a slow cultivation of new business out of funds obtained from operation or paid at the expense of an operating deficit. There is no real reason why any money expended for purely new business by an operating company should be considered as an operating expense. It is rather an expense connected with the construction of new plant or new parts of existing plant, and is a necessary part thereof. It is true that most companies consider it as an operating expense and in doing so they err, if at all, on the conservative side. Then, too, a considerable part of the expense of any new-business department is devoted, not to securing purely new business, but in retaining that which already exists and obtaining substitutes for consumers who discontinue their service for one reason and another. Nevertheless, the fundamental principle appears to remain that money expended in the promotion and securing of new business, for which new plant is required, is essentially chargeable to capital and construction account rather than to operating expenses, and should be considered as a part of the going or running value of any public service enterprise.

DOMESTIC LIGHTING.

In a recent German article, Dr. Bloch takes up that much-neglected branch of electrical lighting, the illumination of houses, both from a practical and artistic standpoint. Domestic lighting is for the illuminating engineer a fascinating study, especially on account of the difficulties that have to be overcome and the opportunities for improvement. In lighting shops and office buildings, the utilitarian point of view is the one generally and naturally adopted; and while it is entirely possible to combine this with inoffensive and, indeed, pleasing fixtures, the lighting of a highly decorated interior is a different matter, involving the artistic side of illumination to an extent which greatly increases the difficulty of obtaining a successful result. The trouble is enhanced by the fact that the so-called artistic interior decoration, while perhaps founded on sound basic esthetic principles, is nevertheless influenced to a very extraordinary extent by fashion; so that an interior which would be considered artistically good this year, in two or three years would be branded as Philistine by most of those in the business, and a few years later there might be a recurrence of earlier types, which had themselves been discarded as gaudy or commonplace.

The main question which arises for consideration is whether the fixtures employed in lighting shall be themselves a part of the decorative scheme or unobtrusive accessories. A second question is whether the quality of lighting shall be subordinated to decorative effect or not. If it be desired to light, let us say, a private library, it is a matter of considerable importance whether or not the owner is willing to put up with thoroughly bad lighting from the illuminative standpoint for the sake of decorative effect. If he is willing, the problem of so-called illumination is a very simple one. If he is not and really wants a well-lighted room, the problem is still simple, but leads to totally different results. In the first case one would have to drop out of consideration all properly screened illuminants, since every kind of efficient shade is cast into outer darkness by the architect and the decorator when it comes to cases of this sort, and so-called art-glass seems just now to be going out of fashion. If good lighting be wanted as a primary requisite, it can be had, but it must be admitted that the ordinary material of illumination leaves something to be desired in the way of unobtrusiveness. In particular, the existing metallic-filament lamps, which form the basis of effective illumination, are large in the bulb, requiring somewhat bulky shades, and they demand these shades on account of their high intrinsic brilliancy. Tinted shades cut down the intensity of the illumination very greatly, and when of sufficient size to cover the ordinary tungsten lamps they are apt to be somewhat too conspicuous.

Abroad some material progress has been made in the production of small-bulb metallic-filament lamps which lend themselves much more readily to artistic working than do the large ones now common. Indeed, foreign makers have gone so far as to produce candle lamps and other small decorative lamps with metallic filaments of comparatively low voltage, stiff enough to be burned in any position. Some efforts in a similar direction have been made in this country, but they have not yet gone far enough to put at the disposal of the illuminating engineer a line of lamps well fitted for use in decorative fixtures of the less obtrusive type. The low-voltage tungsten lamp now coming into considerable use in some cities is especially well adapted to designs with small bulbs which may be readily used in artistic fixtures, even though suitable for comparatively small rooms.

Perhaps the most satisfactory progress in fixtures for domestic work has been made in the line of standing and table lamps, of which some very beautiful examples may be found. In this case the size of the bulb is not an important matter, so that one of the present difficulties is avoided. As a matter of fact, even the standard 25-watt tungsten lamp for ordinary voltages is just enough larger than the 16-cp carbon lamp to forbid its use in many shades adapted for the latter; while the larger sizes, 40-watt, 60-watt and 100-watt, will not go conveniently into any of the closed shades of modest dimensions, and when used in the open shades require these to be of a size which makes them unnecessarily obtrusive. The present tendency in domestic lighting is to make extensive use of side brackets, and there is a great and unfilled need for suitable diffusing shades adapted for use with tungsten lamps on any except large brackets. The great efficiency of tungsten lamps makes it highly desirable to use them for domestic lighting, which commonly has to be paid for at the highest current rate, and the work of adapting tungsten lamps to really artistic and unobtrusive fixtures is one which should be taken up vigorously by the fixture manufacturers in their own interest as well as for the improvement of interior lighting.

N. E. L. A. Convention to Be in St. Louis.

It is officially announced that the coming annual convention of the National Electric Light Association will be held, as anticipated for some time, in St. Louis, on Monday to Saturday, May 23 to 28. The meetings will be held in the new Coliseum building, a steel and concrete structure somewhat resembling Madison Square Garden, and affording excellent facilities for both meeting and exhibit purposes. The exhibits will be located in the main auditorium, the stage will form the main meeting room and in addition there will be three rooms for sectional meetings. In view of the extraordinarily large growth since the last convention, and the fact that the meeting will commemorate the twenty-fifth anniversary of the founding of the association, it is believed that the attendance will be the largest in the history of the body. The St. Louis League of Electrical Interests and other local bodies are already taking an active interest in measures to give the association a Southern welcome.

Coming Meeting of International Congress of Inventors.

The International Congress of Inventors, which was established in 1906 and incorporated in February, 1907, with headquarters in Rochester, N. Y., is to hold its first convention in that city in June, 1910. A feature of the convention will be an exposition of the models of recent inventions and of many interesting models from the Patent Office of industrial devices patented during the earlier part of the last century. It is also being planned, in order to familiarize the public with the details of Patent Office work, to represent with a clerical force the various steps in the entry, examination and granting of patents to applicants. It is stated that although the Congress of Inventors has only been in existence since 1906, it has achieved an international scope, and has among its membership the leading inventors of this and foreign countries. The objects of the organization are stated to be as follows:

To establish a standing for a United States patent independent of any court action and to obviate the necessity of testing a patent in the courts. To procure legislation or action by the Federal or State governments when needed. To reform abuses and secure freedom from unlawful and unjust exactions. To promote intercourse among the members of this association for their mutual interests.

To maintain a headquarters in charge of a secretary who shall procure data for the use of the members, build up a library, direct members to sources of information on all matters pertaining to patents, collect statistics generally and specifically for the use of the members, keep on file the records of the Patent Office, bulletins and periodicals relating to patents, and maintain a list of patent attorneys whom the association can recommend to its members.

To present the solid front of a strong international organization whenever necessary to assert the rights of members collectively or individually. To acquaint the members with what is going on throughout the world in the great fields of industry, all of which are dependent upon the brain of the inventor. To advise an inventor who may be in need of advice as to the procedure which would be most advantageous to him and to employ the best legal talent in the land whenever it may be necessary to defend the interests of the association.

To keep always in mind the mutual advantages of organization and break down the barriers which have too long kept inventors apart and at the mercy of corporations and others that, for but a small consideration, would take from an inventor what is often of great value and simply because the inventor lacked the protection which organization would give. In the association there will be the fullest freedom for individual action on the part of a member with regard to his own invention and patent business, entirely independent of his connection with the association, the secrecy surrounding his invention being in no way affected.

The necessity for such an organization is pointed out as apparent when it is considered that there are between 200,000 and 250,000 inventors in the United States alone, yet who have been powerless to assert their rights for lack of organized effort when it became necessary to appeal to authorities for redress. While the inventor as a single unit is quite powerless before the Congress in Washington or any of the congressional committees in matters relating to the rights of an inventor or of inventors as a class, a powerful, organized body of inventors commands respect and consideration. This is stated to be proved by what the Congress of Inventors has already been instrumental in achieving, for instance, in the matter of an increase in the force of examiners in the United States Patent Office, increase in the salaries of examiners, preservation of the models in the Patent Office and the giving an impetus for the erection of a new and suitable Patent Office building.

The International Congress of Inventors has a secretary, assistant secretary and clerical force, a valuable library and complete Patent Office and congressional files, a tabulated record of a large number of inventors, patent solicitors and lists of great industrial corporations, firms, Chambers of Commerce, Boards of Trade, etc. It is stated to be increasing continually. Its officers are as follows: President, Mr. George F. Gallagher, Rochester, N. Y.; vice-presidents, Messrs. A. B. Lamberton, Rochester, N. Y., and H. LaCasse, Los Angeles, Cal.; secretary, Mr. Ralph T. Olcott, Rochester, N. Y.; treasurer, Mr. George B. Selden, Rochester, N. Y. Among the directors and members of committees are Mr. Walter S. Strowger, Rochester; Mr. George B. Selden, Rochester, and Mr. Henry L. Doherty, New York.

Chicago Electric Club's Successful Year.

A combination business meeting and "Dutch lunch" marked the meeting of the Electric Club of Chicago, held on Jan. 26, which was the last meeting for the fiscal year 1909-10. The report of Mr. J. G. Pomeroy, the treasurer, for the year was presented and showed that the receipts for the year were $1,635.97 and the disbursements $635.67, leaving a gain in net cash assets during the year of $1,000,30. The total amount now on hand in the treasury of the club or in banks is $2,094.34, being nearly $5 for each member. During the year 99 new members were received, the total membership now standing at 423. Mr. Pomeroy's excellent report was received with much applause.

Mr. F. S. Hickok reported in the matter of adopting a club emblem, as recommended by Mr. C. A. S. Howlett, former president. The emblem suggested, which was officially adopted by the club, consists of a shield bearing the "Y" of the Chicago municipal emblem, symbolizing the branches and main stream of the Chicago River. In the three spaces on the shield between the three lines of the "Y" are the letters " T E C," standing for The Electric Club.

The committee on certain other recommendations of Mr. Howlett reported through Mr. W. E. Keily. In relation to the suggestion that the proceedings of the club be published at monthly or quarterly intervals in permanent form, the expense to be defrayed by printing advertising pages, it was decided that it would be wiser at the present stage of the club's development to lay the matter on the table. The club is a social organization as well as an electrical society, and it was thought that at the present time the publication of formal proceedings would involve expense and machinery which are inadvisable and to some extent in conflict with the diversified purposes of the organization. In relation to Mr. Howlett's suggestion that the club correspond with similar clubs with a view of forming a federation of electric clubs, to recognize one another's cards of membership, Mr. Keily reported, for the committee, that the suggestion was worthy of further consideration, and on his motion the recommendation was referred to the incoming board of managers for action at some future date.

A "social session" followed, and brief speeches were made by Messrs. T. G. Grier, H. F. Holland, E. F. Kirkpatrick, James

R. Dean, V. L. Crawford, of St. Louis; Henry Newgard, H. T. Matthew, W. R. Thomas, of St. Joseph, Mo.; Frank L. Perry, Lieut. Ben D. Foulois, of the United States Army, and C. L. Hight, of Boston. Besides those mentioned among the speakers there were several other out-of-town men present, including Mr. F. C. Barrington, of St. Joseph, Mo., and Mr. Corey, of Indianapolis.

Decision in Winnipeg Municipal Ownership Case.

The action involving the principle of municipal ownership which was brought by the city corporation of Winnipeg against the Winnipeg Electric Railway Company, arising out of the distribution of electric energy generated outside the city limits which the city claimed was in violation of the company's franchise has resulted in a win for the municipality, and finally come to a conclusion. The court has ruled that the company, which recently built a hydraulic plant at Lac du Bonnet, 60 miles distant from the city, on the Winnipeg River, at a cost of nearly $1,000,000, cannot legally bring that power into the city for commercial purposes, and that an order may be secured for the chopping down of any poles or wires which may be erected to carry this power for distribution inside the city limits. The entire costs of the suit are to be paid by the company. The litigation, to which frequent references have appeared in these columns, dates from 1906.

Close of the Chicago Show.

With enthusiasm unabated to the last, the fifth annual Chicago Electrical Show came to an end on Jan. 29. The attendance during the show exceeded by 20 per cent the best attendance at preceding shows in Chicago. During the early days of the first week there were not as many visitors as the management might wish, owing no doubt to the unfavorable weather, but on Saturday, Jan. 22, there was a great crush, and the attendance of the second week was very large.

In character of exhibits, in beauty of illumination and decorations and in the combination of business success and popular attractiveness, as well as in attendance, the show left nothing to be desired. The general estimate is that it was entirely successful. When the show was started four years ago by the Electrical Trades Exposition Company there was some question whether a purely electrical exhibition would win popular favor year after year, but the attractions have been skilfully diversified year by year, and the wisdom of the founders has been justified.

Proposed Maryland Public Utility Bill.

Among the points of the public utilities bill now before the Maryland Legislature which are being criticized is that the duty for examining and testing gas and electric meters is taken from the Department of Lamps and Lighting of the city of Baltimore and conferred on employees of the proposed commission, who may not be residents, though their salaries would be paid by the city. A resolution will be introduced in the City Council requesting City Solicitor Poe to examine the bill as it has been approved by the Governor and point out the different provisions that affect the city government to the extent of relieving officials of important duties dealing directly with the taxpayers. The Electrical Subway Department, which is in charge of Engineer Charles E. Phelps, seems to be seriously affected by the first clause of the bill defining the general powers of the proposed commission relative to gas and electricity. This clause says:

"The commission shall have general supervision of all persons and corporations having authority under any general or special laws, or under any charter or franchise, to lay down, erect or maintain wires, pipes, conduits, ducts or other fixtures in, over or under the streets, highways and public places of any municipality for the purpose of furnishing or distributing gas, both natural and artificial, or of furnishing or transmitting electricity for light, heat or power, of maintaining underground conduits or ducts for electricity conductors."

It has been pointed out that the city is a "corporation" which "maintains conduits for transmitting electricity for light, heat or power." The clause is a broad one, and does not include a sentence that exempts the city of Baltimore or any of its commissions or other agencies from the provisions. The conduits are among the city's best assets, yielding in the neighborhood of $100,000 a year.

There was some complaint among the State Senators because this bill had not been printed and placed on the desks. It was thought that in view of its importance and voluminousness it should have been printed at the earliest possible moment, without waiting for the completion of the engrossing. As a matter of fact, it has not yet appeared. The effect of recent criticism will be to cause the bill to be rigorously scrutinized in Baltimore when it does finally emerge from the hands of the printer.

Report on Wisconsin Water-Powers.

In the first report of the special legislative committee on water-powers, forestry and drainage, just made by two members of the committee, Senators Paul O. Husting and Henry Krumreym, it is shown that 827,900 hp is available for development on the 12 principal streams of Wisconsin, namely, the Wisconsin, Fox, Wolf, Menomonie, Peshtigo, Oconto, Black, Chippewa, St. Croix, Rock, Milwaukee and Flambeau Rivers, and that only 183,105 hp has been developed. The introduction of the report said:

"Wisconsin is rich in its potential water-powers. While there has been some development of these natural powers, it may be said that such development is still in its infancy. As was natural, the rivers in lower Wisconsin were first available for water-power, and for that reason show a larger percentage of development, but the rivers of northern Wisconsin, affording the greatest water-power possibilities, may be said to be scarcely touched."

By investigation the committee found that to produce 200,000 hp it would require approximately 1,500,000 tons of coal per annum, which at $3.50 per ton represents a saving in coal of $5,250,000 per annum by using water-power; on the total development of 1,000,000 the saving would be just five times as great, or 7,500,000 tons of coal at a value of $26,250,000 per annum.

"The saving of coal thus shown is startling, and yet the figures are given by one who should know and who is a recognized authority," the report says. "But even if exaggerated, we cannot help but be impressed by the tremendous conservation of the coal supply which would thus result.

"Thus, we find a twofold advantage in the use and development of water-power. First, a great saving in the cost of production of power, and secondly, the conservation of the coal for use and generation of power in communities less favored by nature than Wisconsin. It is not then surprising that we awaken to the realization of what the utilization and conservation of our water-powers mean to the State and Nation. With the exhaustion in the coal supply already forecasted, we are appreciating that then but one source of power will remain, the falling water.

"Not only, however, have we begun to fear the exhaustion in the coal supply, but another fear confronts up, namely, the fear that the water-power, like the coal fields, will become the property of and for the benefit and profit of the few, instead of for the use and benefit of the many. That this fear is not entirely groundless may well be conceded.

"The committee found no evidence of any water-power trust in Wisconsin, but while there is an absence of anything showing any such trust in the State, we are inclined to believe that what has occurred by way of monopolization of her great natural resources in the past is not improbable in Wisconsin in

the future. History and experience has taught us that nearly everything of necessity and value in the way of natural monopoly has been monopolized. Therefore, it behooves the people to take such steps to prevent such monopolization of the water-powers in this State."

The most important recommendations made by the committee are as follows:

The State should declare in unmistakable terms that the use of water in navigable streams and lakes for power developed under a franchise from the State is a public use; and all of the energy developed or undeveloped of the water in the navigable streams of the State is subject to the control of the State for the greatest public good.

The State now regulates and controls, under the public utility act, the distribution of power, whether generated by coal or water. The State should declare that the beneficial use and neutral energy of the waters of the navigable streams and lakes of this State for all public uses belong to the State in trust for all of the people. The Legislature should assert that the State is trustee for the people of the beneficial use in and to the neutral energy of the waters of the navigable streams and lakes for public uses as against the individual.

No franchise should hereafter be granted to any person, firm or corporation for the erection and maintenance of any dam upon any navigable stream, except for the improvement of navigation and the development of hydraulic power or, in addition thereto, for any public purpose.

All dam franchises granted by the Legislature in the past so far and to the extent as the same are subject to repeal, should be repealed, and the holder thereof be required to file a written acceptance of a franchise subject to all the conditions herein recommended.

No franchise should ever be granted in perpetuity, but should be for a definite period only. Such periods should be no longer than is required for reasonable safety of investment. It is recommended that no franchise be granted for a longer term than 20 years with the privilege of continuance for two further and successive terms of 10 years each, at the option of the grantee.

A reasonable franchise fee should be imposed. The committee recommends the levying of 10 per cent on the annual franchise value per horse-power. By annual franchise value is meant the difference in cost between the production of horse-power by water-power and the production of horse-power by steam-power at the same place in like quantities and under like circumstances.

The State should fix the location, height, and general construction of the dam in order that the power may be developed to its highest potential efficiency as well as to promote public safety. The State should prohibit any monopolization of water-power upon pain of forfeiture of franchise. The State should reserve the right whenever the public necessity requires to take over and condemn any water-power for a public purpose.

The substantial compliance with all the provisions of law should be compelled under penalty of forfeiture of franchise. At the expiration or forfeiture of franchises all rights exclusive of physical property should revert to and become the property of the State in trust for all the people. The grantee of a franchise should be required to keep records and accounts open to inspection by the State similar to those kept by the public utilities, as required by law.

The committee reported as follows on reservoir systems.

"In the bill which we submit with this report containing in substance the matters recommended, it is provided that such bill shall not apply to reservoir systems and this for the reason that in the very nature of it, entirely different provisions are necessary and some of these would be inapplicable.

"We do recommend, however, that until the State gains the power to create these reservoir systems, that any future grants along that line be made with the most careful safeguards that can be devised to enable future Legislatures and the State to properly deal with them. The Wisconsin Valley Improvement Company is surrounded by safeguards, but we would recommend that all provisions of the bill to create sections be made to apply to storage reservoirs so far as the same may be applicable and such other safeguards as wisdom may dictate."

The forestry and drainage problems are also discussed in the report and recommendations made. The report by the other members of the committee has not yet been made. It is not known whether one or two more reports will be submitted.

Austin (Tex.) Proposed New Power Plant.

A second proposition for the rebuilding of the great dam across the Colorado River at Austin, Tex., has been submitted to the Mayor and city commission. This last proposal comes from a syndicate of Scranton, Pa., men, composed of Messrs. A. B. Potter, W. M. Sturges, T. W. Holland and others. The contract which this syndicate desires to enter into with the city provides for the rebuilding of the dam and the operation of the municipal electric light and power plant. The syndicate agrees to construct the dam and hydroelectric plant and to have the same ready for operation within two years from the date of signing the contract. It is proposed that the city shall pay the syndicate the sum of $60,000 annually in two equal semi-annual installments for a period of 30 years, or a total of $1,800,000. This money shall not only be in payment of the light and power furnished by the syndicate, but it will give the city the ownership of the dam and hydroelectric plant at the expiration of 30 years. The proposed contract provides that a minimum of 1000 hp shall be furnished the city during the life of the contract; the city to lease its water privileges on the Colorado River, reserving to itself only the boating and fishing rights.

The right to use the present steam plant in case of water shortage is reserved by the syndicate. The city shall receive without extra cost all over 1000 hp produced by the dam and shall pledge the earnings of the present and future plant to cover the payment of $60,000 annually. The proposition is being considered by the Mayor and municipal commission, and if pronounced fair and feasible it will be submitted to a vote of the people of the city.

Mr. C. J. Zeitunger, of St. Louis, Mo., has also submitted a tentative proposition to the municipal government to rebuild the dam. He is preparing plans and specifications for the proposed structure.

Water-Power Monopoly.

At a recent meeting in Denver of the Colorado Electric Club, Mr. D. C. Beaman delivered an address in which the attitude of the U. S. Forest Service in relation to control of the water-powers of national forests was vigorously attacked. Referring to the fears of water-power monopoly, he said these are baseless so far as any practical possibility in the Rocky Mountain region is concerned.

Owing to the great descent of streams in that region, power plants can be built on private land a few miles below any existing reservoir, and the water coming from the reservoir above conducted by conduit to a sufficient height to give the required fall and the plant operated through a penstock without any dam or reservoir whatever. Any number of power plants can thus be built and operated, the reservoir above being the reservoir for all, but having no right to charge for the water in any respect.

On the other hand, any charge in forests will give advantage and monopoly to power companies outside of the forest, including the innumerable immense plants existing in the East, where the land has all passed into private ownership, none of which is, or ever can be, subject to such charges.

The idea of requiring power companies to assign their water rights to the Government, as intimated by the Secretary of the Interior in his last report, is, Mr. Beaman stated, indefensible from every standpoint, and the constitutional right to assign or acquire in such case is, he believed, wholly lacking.

California Municipal Plants.

Reports on the operation of municipal water-works, electric light plants and wharves have recently been received by the State Controller of California from a large number of incorporated cities and towns. Of the 11 municipal electric lighting plants, the most important are those of Pasadena, Riverside and Alameda. Last year's receipts, including receipts from bonds, were: Pasadena, $195,118.92; Riverside, $114,334.49; Alameda, $108,175.02. Expenditures of all kinds were: Pasadena, $132,757.30; Riverside, $96,741.04; Alameda, $103,010.28.

Fire Risk of Moving-Picture Shows.

A recent fire in a moving-picture show in Baltimore, through neglect of safeguards, brought out that a number of such safeguards originated in the office of Chief Electrician Kingsbury, of the office of building inspection, and have been adopted through the country as preventatives of fire. One of these is an automatic shutter to keep the intense light from shining on the films unless they are passing through it so rapidly that no damage can result. As long as the films are going at the rate of 50 ft. or more per minute, the shutter allows the light to shine on the films, but the moment that the speed decreases the shutter drops and the light is shut off from the films. It was found that in the fire noted, the shutter was fastened back with a rubber band. It was also found that a shield which should be placed below the head of the machine to guard the films on the way to the protected roll below where they are again coiled up, had been removed, thus allowing the heat to play on the films below the focus.

Applications of the Gyrostat.

An enthusiastic audience numbering almost 300 attended the lecture delivered by Prof. W. S. Franklin before the New York Electrical Society on Jan. 27, the subject being "The Practical Applications of the Gyrostat." The speaker explained in a simple manner the force exerted by the gyroscope when any attempt is made to alter its plane of rotation, the tendency being for the device to resist the motion by a slow precession in a direction such that the gyroscope would finally rotate in the direction of the imparted motion. An effective method for causing a gyroscope to resist a force in a certain direction is to hasten the precession caused by the motion producing the precession. Upon this method is based the stabilizing action of the gyroscopes used for preventing the rolling of ships and the overturning of monorail cars. In the Brennan car the gyroscopes are so mounted that the precession action is hastened by the friction between an extended shaft of each gyroscope and a surface against which it rubs when displaced from the normal position. In the Scherl car the hastening of the precession is accomplished by means of a piston moving in a cylinder containing oil, the pressure of which is varied, by an electric motor, according to the force of displacement to which the gyroscope is subjected.

A small working model of the Brennan car was shown in operation upon a rope suspension track. Mr. H. H. Barnes read a discussion of this type of car as proposed for actual passenger service. A discussion of the characteristic features of the Scherl car by the inventor was also read. Mr. T. C. Martin read a communication from Mr. Frank J. Sprague in which attention was directed to certain early applications of the gyroscope in marine service.

Mr. E. A. Sperry showed many illustrations of the Schlick device for preventing the rolling of ships. In a certain test conducted by the speaker the rolling of the ship was reduced from 16 deg. to about 1 deg. when the gyroscope which had been clamped in position—although revolving at full speed—was allowed to operate under its automatically hastened precession.

Prof. William Hallock explained the advantages of utilizing the gyroscopic principle in stabilizing an aeroplane in flight against all wind disturbances.

Mexican Electrical Developments.

Mr. G. A. Mitchell, of London, England, and associates who are interested in the Michoacan Railway & Mining Company and the Michoacan & Pacific Railway Company, are preparing to utilize the waterfalls near Zitacuaro for the development of a large amount of electrical energy. The site of the proposed hydroelectric plant has been selected. The power will be transmitted to mining districts and industrial centers of this region.

Aristides Betancour, of Mexico City, has made application to the Federal Government for a concession to establish a large factory in that city for the manufacture of dynamos and various kinds of electric machinery and equipment. He agrees to invest not less than $150,000 in the industry.

The American Smelting & Refining Company is installing a large electric power plant at its smelter near Chihuahua. The Government of Hidalgo has granted a concession to Francisco Martinez Arauna, of Pachuca, for the construction of a hydroelectric plant on the Tepeji River. He will furnish lights and power for the city of Tepeji del Rio. The Sierra Consolidated Mines Company, which has its headquarters at Duluth, Minn., is preparing to construct a hydroelectric plant in the vicinity of its mines near Parral, State of Chihuahua.

The Mexico Light & Power Company is arranging to extend its light and power service to 30 more towns and villages in the valley of Mexico. Contracts have already been made for this service in Texcoco, Xochimilco, Santa Anita, Ixtacalco, San Juanico, Mexicalzingo, Culhaucan. Ixtapalapa, Hastahuacan, Meyehualco, San Lorenzo, Hacienda San Nicolas, Zapotitlan, Tlaltenco, Reyes, San Sebastian, Zapotla, San Mateo Magdelena, Aculco, Santiago, Santa Marta, Santa Catarina, Mas Arriba, Santa Maria, San Antonio, Tomatlan, La Turba, La Purisima and San Pedro Atzcapotzaltongo. The transmission cables to these towns are now being erected.

The Central Mexico Light & Power Company has purchased all of the holdings of the Electric Light & Power Company of Leon, State of Guanajuato. The former company has also acquired the concessions to use water of the Guero waterfalls for the generating of electricity and to build transmission lines to Leon and various other places in this part of the State of Guanajuato. It is stated that the price paid for the property of the local company was about $900,000 Mexican currency. The Central Mexico Light & Power Company is said to be a subsidiary concern of the Guanajuato Light & Power Company. It recently issued bonds to the amount of $2,500,000 gold, all of which were quickly subscribed in New York. The proceeds from the sale of these bonds will be used to construct a large hydroelectric plant at the Guero waterfalls. This plant is already partly constructed. It will have a capacity of 20,000 hp. The city of Leon has a population of about 80,000 people, and is one of the most important manufacturing centers in Mexico. The company will not only supply Leon with lights and power, but it will build transmission lines to the great plantation of Oscar Braniff, where the power will be used to operate irrigation pumps and for other industrial purposes.

Negotiations are pending for the purchase of the two electric light plants at Tampico and their consolidation by a syndicate of Americans. It is stated that the plans of the syndicate also include the construction of an electric railway between Tampico and the suburban town of La Barra, six miles.

The Engineering of Chicago.

At the annual meeting and dinner of the Western Society of Engineers, in Chicago, on Jan. 12, Mr. Bernard E. Sunny, president of the Chicago Telephone Company, presented an instructive paper on "The Engineering of Chicago." Mr. Sunny submitted a list of proposed permanent city improvements relating to sewers, waterworks, steam-railroad terminals, better pavements in the business district, deep waterway, harbors and subways, and also, as the greatest of all, the "Chicago Plan" of the Commercial Club.

In relation to sewers, the speaker pointed out the great need

of improvement, and remarked that it is a common sight in Chicago after rainfall to observe repair men of the telephone and central-station companies at work around manholes which are filled with water. Speaking of a high-pressure water system, he thought the expense would be justified and that the money expended ($3,800,000 to cover the central business district) would be well invested. In relation to steam-railroad terminals, the plan of Mr. F. A. Delano, president of the Wabash Railroad, was referred to with approval. This plan for the group location and joint working of terminals has been described briefly in a previous issue of this journal. The plan of the Board of Local Improvements for replacing pavements in the business district was also enumerated.

Considering the subject of a deep waterway from the Lakes to the Gulf, Mr. Sunny noted the fact that the people of Illinois have authorized an expenditure of $20,000,000 for this work, and he gave an idea of the scope of the proposed enterprise. Improved harbor facilities were discussed briefly by the speaker, who then took up the subject of subways and mentioned the plan proposed by Mr. Bion J. Arnold seven years ago, and also the elaborate investigation of the City Council committee on local transportation in relation to the same subject.

The "Chicago Plan," with which the readers of these columns are to some extent familiar, was discussed at some length and the leading features of the project were outlined. The question has arisen in Mr. Sunny's mind whether the city is equipped in an engineering way properly to analyze and harmonize all of the suggestions in the plan and finally to fix upon one comprehensive scheme which shall embody all of the proposals or such of them as are found good. The city is now without the necessary engineering organization and facilities for undertaking so large a task. Heretofore, engineering problems which arise from day to day have been settled as seemed best at the time, without any special reference to the future. Now with all these splendidly thought-out suggestions of vitally needed improvements, plus the routine requirements of a large and growing city, the time has arrived, in Mr. Sunny's opinion, when the city should be supplied with a board of high-class engineers to which shall be referred all data on the property now owned by the city and all of the suggestions that have been made in relation to improvements. On this board there should be specialists having to do with the several subjects involved, as subways, waterworks, sewerage, railways, harbors, etc. The "Chicago Plan," for instance, does not include subways and it should be the duty of the proposed board of engineers to make these various suggestions harmonize.

In the matter of the subways alone there are many differences of opinion and there has not been time apparently to make a general survey of the situation as affecting the whole city, rather than to the central business district alone. In New York the elevated railways and subways together carry a daily average of 1,720,000 passengers, while all of the elevated railways in Chicago put together carry only 450,000. In Chicago there is a greater mileage of street-railway track and a larger number of cars of all kinds in proportion to the traffic than in New York. This means less efficient operation in Chicago than in New York.

Mr. Sunny pointed out that it may be possible to rearrange the transportation lines in Chicago, especially in connection with the proposed subways, so that all main routes may run in a north-and-south direction only, giving more efficient service. He proposed for the consideration of his hearers a four-track subway in State Street, from about Twelfth Street to about Indiana Street, for surface lines; a three-track subway in Dearborn Street, from about Twelfth Street to Chicago Avenue, and in Chicago Avenue to North Franklin Street, for elevated service, and a four-track subway in Clark Street, from about Twelfth Street to Indiana or Ohio Street, for surface lines. Various links to connect this system were suggested. The arrangement is such that it would permit of the removal of all surface tracks on the north-and-south streets in the Loop district except on Wabash Avenue and on all of the east-and-west streets except Randolph, Madison, Adams and Van Buren streets. It would dispose of about seven-tenths of the surface lines in the Loop district and possess many advantages. A number of streets are left for future subways as the city grows. Low-level subways have been tried in London and have proved a failure, and they will probably not be built in Chicago. It is more likely that subways will be limited to as small a mileage as practical and operated at a high level.

Curiously enough, in Mr. Sunny's judgment, it is not any subway work done recently in any city that is the best, but rather the subway built 30 years ago under Park Avenue, New York, from Thirty-third Street to Forty-second Street. This is immediately under the surface and has many openings which admit light and air. State Street, in Chicago, is wide enough to permit of similar treatment, but other downtown thoroughfares are not. The subways in Chicago will be built for all time, and it will be an inexcusable blunder if the best engineering talent is not secured at the outset for the purpose of solving the problem.

The speaker closed by referring at some length to the financial aspects of the question. He said that commercial Chicago is 30 years ahead of municipal Chicago. "We shall not do our beloved city justice," said Mr. Sunny, "by equipping her to hold the position among the greatest cities of the world, which is her manifest destiny, until we get together and add to our civic pride the courage to supply the money and confidence that it will be well spent." The concluding recommendation of Mr. Sunny's thoughtful address was that the so-called consolidation bill should be again urged upon the General Assembly of the State in the interest of a better and more efficient municipal organization in Chicago, especially for the purpose of financing needed permanent improvements. Furthermore, the city should be encouraged to make the necessary expenditures for a board of engineers to prepare a comprehensive engineering plan for Chicago's future public works.

Following Mr. Sunny's paper, Alderman B. W. Snow, chairman of the finance committee of the City Council, spoke of the importance of the local transportation problem in all cities. In considering this problem, all types of railways should be considered together.

Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railway, remarked that there are 2200 miles of steam-railroad tracks in Chicago. He believes that the sooner the railroads face the electrification problem and work it out, the better it will be for them. Otherwise they may be forced to adopt electrification under duress and so be unable to give the subject the careful consideration which its importance demands. If the Delano plan of group railroad terminals be adopted, it will simplify the problem. The cost of electrification will soon be reduced by the work of electrical engineers and the point will be reached when it will be more economical to operate by electricity than by steam locomotives. Alderman M. J. Foreman, chairman of the local transportation committee of the City Council, next spoke.

Mr. B. J. Arnold, who closed the discussion, pointed out that in Chicago the surface and elevated railways were needed as well as a subway. He believed in the consolidation of the local railway interests in Chicago, but it should be accomplished in such a manner as to distribute equitably the revenue from long-haul and short-haul traffic.

Wood Preservation.

At the annual meeting of the Wood Preservers' Association, which was held at the Auditorium Hotel, Chicago, on Jan. 18, 19 and 20, several papers were presented on the general subject of preserving wooden structures from decay. The association is composed of men who are interested in plants for wood preservation, largely for steam-railroad companies. Such subjects as the proper time for cutting timber, inflammability of treated timber, characteristics of various retort doors, amounts of antiseptics required per cubic foot of material treated, and results obtained by treating with crude petroleum, were dis-

cussed. In addition, precautions to prevent fires at wood-preserving plants, amount of creosote oil to be regained from treated ties by means of a final vacuum, and mechanical characteristics of operating plants were considered.

Mr. Andrew Gibson, superintendent of timber preservation for the Northern Pacific Railway Company, at Brainerd, Minn., discussed briefly "Economics of Cables, Electricity or Locomotives in Moving Materials at Plants." In the tie-treating plant at Brainerd an electric locomotive is used to handle the retort cars around the yard. This locomotive weighs 10 tons and is operated at 250 volts, direct current, electricity being furnished by a 50-kw generator. It is operated on a narrow-gage track about 3300 ft. long. This machine has given satisfactory service, but perhaps is a trifle light. If it were five tons heavier, Mr. Gibson thinks that it would be ideal for the character of work required. Less than $2 has been spent on it for repairs since it was placed in service over two years ago. The generator furnishing the electricity also supplies energy for lighting the yard and buildings.

In relation to the treatment of timber with crude petroleum, Mr. C. Marshall Taylor reported that two railroads, the National Lines of Mexico and the Santa Fé, have undertaken the use of this method. This kind of treatment is radically different from all others. Heretofore it has been considered essential to have in the preservative medium an element that was either germicidal or antiseptic in its nature, but the crude-oil treatment depends upon an entirely new conception of preservation, and that is the elimination of air and moisture, proceeding on the theory that in order that fungi may thrive, there must be present three essential conditions—moisture, air or oxygen, and the proper temperature. Timbers treated with crude oil have been used in an experimental railroad track near Pelican, Tex., for over three years, and some ties taken out of that track recently for examination were found to be entirely free from all indications of decay. As yet, pine has been the principal wood used in the experiments, and there is apparently no difficulty in impregnating thoroughly all the sap wood of the different species of pine. The success of the treatment depends upon the thorough impregnation of the sap wood with all the oil that it is possible to force into it.

Mr. R. L. Allardyce had a paper relating to the amounts of various antiseptics required per cubic foot to obtain good results. In the creosoting process, the speaker recommended a treatment of from 12 lb. to 15 lb. to the cubic foot for telegraph and telephone poles. For ties he advocated a 10-lb. treatment. In the zinc-and-oil method he suggested a solution of zinc chloride, using about ½ lb. of dry salts to the cubic foot, making practically a 4 per cent solution; then an injection of from 3 lb. to 4 lb. of oil. For the straight zinc or burnettizing process, the same amount of dry salts to the cubic foot is suggested, but in the ratio of ½ lb. of dry salts to 15 lb. of water, making practically a 15-lb. treatment to the cubic foot.

"Inflammability of Treated Timber" was the subject of Mr. H. M. Rollins. He confined himself to two processes, burnettizing and creosoting. The former is a treatment with zinc chloride and the presence of this preservative in the timber not only does not increase its inflammability, but on the other hand, to a great extent fireproofs it; any attempt to burn timber treated with a solution of zinc chloride will demonstrate that it is less inflammable than a similar piece untreated. In relation to creosoting, or treating timber with the dead oil of coal tar, there has been considerable prejudice due to the impression that the timber so treated is very inflammable, but Mr. Rollins is quite clear that creosoted material becomes, after a short time, less inflammable than similar wood untreated. Timber freshly treated with creosote is less liable to burn than untreated material, but its degree of inflammability decreases gradually as it grows older, until after a certain length of time, which is variable, it is no more inflammable than untreated material; from that time on it becomes less inflammable than untreated material and finally reaches a point where a great deal of heat is necessary to ignite it. This is due to the gradual vaporization of the inflammable constituents of the oil.

The speaker gave the result of a test on an electric lamp pole which had been treated with 11 lb. of oil per cubic foot four years before the test. It was compared with an untreated pole of slightly larger diameter than the one treated. Fires were kindled around the bases of two poles in exactly the same manner. The two poles ignited about the same time and in a few minutes were blazing freely for about 5 ft. above the ground. After the poles were burning, the coals around the bottoms were removed and the poles allowed to continue to burn. The creosoted pole continued to burn for about 10 minutes when the fire ceased and the only damage was a surface charring about ¼ in. deep, reaching as high as the fire on the ground from the pile of kindling reached. Above that point, as high as the flames reached, the pitch-like coating was burned until it had the appearance of lamp-black. The untreated pole continued to burn at a point near the ground and fell after burning for 2.5 hours, burned completely in two. This test seems to demonstrate that it would be impossible to burn a well-seasoned, creosoted pole with a grass fire, as sometimes happens with untreated poles.

After the reading and discussion of several other papers, officers were elected as follows: President, Mr. Walter Buehler, St. Louis; first vice-president, Mr. C. W. Berry, Laramie, Wyom.; second vice-president, Mr. David Allerton, Madison, Ill.; third vice-president, Mr. C. E. Chanute, Chicago; secretary and treasurer, Mr. F. J. Angier, Galesburg, Ill. Chicago was selected as the place of the next annual meeting.

Meter Testing Discussed at Meeting of Empire State Association.

A sectional meeting of the Empire State Gas and Electric Association was held in the offices of the Rochester Railway & Light Company, Rochester, N. Y., on Jan. 20. Forty-one were present at the meeting, which was devoted entirely to a discussion on electric meter testing. Mr. R. M. Searle, vice-president of the association, presided, and after stating the reasons for holding the meeting, called on Dr. Clayton H. Sharp, of the Electrical Testing Laboratories. Dr. Sharp pointed out the necessity of maintaining meters at a high degree of accuracy in order to insure the full income to which the companies are entitled, stating that the frequency at which tests should be made depends largely on the type of meter and on the conditions of operation.

Mr. Searle then gave some statistics showing the number of companies in the State that are not testing meters at all, and those that are testing only a very few meters. He also quoted from the report of the Public Service Commission as to the accuracy of meter tests reported to the commission during the last year.

Mr. C. G. Durfee, chief of the meter department, Rochester Railway & Light Company, suggested that in case any individual company did not feel that it could afford to do the testing itself, arrangements might be made either with some larger company in the neighborhood or with some reliable concern engaged in this business, whose tests would be acceptable, not only to the company and the consumer, but also to the Public Service Commission.

Mr. S. G. Rhodes, engineer of the meter department, Yonkers Electric Light & Power Company, agreed with Mr. Durfee's suggestion that meters be tested regularly, but said that the work should be done by some independent testing authority, such as the Electrical Testing Laboratories or similar organization. He suggested that while meters were being tested it would be advisable whenever possible to substitute a diamond jewel in place of the usual sapphire in order to secure greater efficiency on light load. He also mentioned the assistance which a bookkeeper or an accounting department could give to a meter department in reporting all serious variations in bills and also in reporting all cases where the meter showed no consumption. Reasonable accuracy in a meter, such as would be probable with regular testing, would not give a customer any cause for com-

plaint, whereas a policy of letting a meter run slow over a long period and then restoring it to accuracy would result in serious dissatisfaction with the company.

The importance of the accounting department as an aid to the meter department was emphasized later by Mr. Searle and by Mr. E. C. Scobell, who stated that the Rochester Railway & Light Company had transferred one meter tester to the accounting department for the purpose of watching the variation in the consumption as recorded by the meters and reporting to the meter department matters which, in his opinion, needed investigation. He said that much money had been saved in this way and that some errors in reading meters had been discovered before the bills had been sent out. Mr. Searle called attention to the tentative report of the accounting committee of the association, presented at the annual meeting, which included a method of meter accounting and a system for keeping a record of all meters, tests made, etc.

A very interesting comparison of the importance of maintaining the accuracy of meters and of economies in other operating matters was made by Mr. J. C. Parker, of the Rochester Railway & Light Company. Mr. Parker said that a company the size of the Rochester company, generating power by steam exclusively, would have a ratio of gross earnings to coal bills of 10 to 1. Two per cent saving in coal, however, would be of about the same importance in a company's earnings as one-fifth of 1 per cent increase in meter readings. Therefore, if a company could afford to pay $50 a year for a 2 per cent coal-bill saving, it could afford to pay $500 to insure a 2 per cent increase in readings, and as electric meters always had a tendency to run slow, the average effect of meter testing was in the direction of increasing the meter readings.

Mr. Parker added that this ratio of 10 to 1 between gross earnings and coal bills applied to large companies only. The small companies naturally had a larger selling price in proportion to the fuel expense since they had to carry a relatively greater equipment investment owing to their essentially poor load factors. Therefore, the ratio of gross earnings to fuel expense would be nearer 25 to 1 for such companies, and would, in consequence, lay greater stress upon the meter department.

After further discussion, Dr. Sharp called attention to the greater degree of accuracy possible in selling electricity than in selling other commodities. He mentioned the purchase of coal and said that although the coal dealer might have accurate scales and might do as fairly as possible in his weights, there was almost certain to be a greater or less quantity of moisture included with the coal, and naturally the purchaser stood the loss. He also mentioned the purchase of ice, and the question of whether the tongs were included in the weight and the amount of waste between the time of weighing and the time the ice was actually delivered. In closing his remarks he said that it placed the electric light salesman in a very strong position to be able to say that he measured the commodity he delivered more accurately than was done by any other dealer from whom purchases were made. The electric salesman was in a good position to be able to say that if he was taking proper care of his meters.

In closing the meeting, Mr. Searle stated that the association would be pleased to be of all assistance possible to the small companies in this very important matter and that the secretary, Mr. C. H. B. Chapin, would be very glad to hear from such companies as might be unable to attend to the testing themselves, but desired to have it done.

When the meeting adjourned the delegates were entertained at lunch at the Hotel Seneca by the Rochester Railway & Light Company and afterward they were taken through the meter shop and laboratory and inspected some of the other works of the company.

Wisconsin Rate Commission News.

The Wisconsin rate commission has authorized the Beaver Dam Light & Power Company to issue $60,000 par value of bonds of the denomination of $500 each, to bear interest at the rate of 5 per cent per annum, and to mature within 10 years from date. In accordance with the State law every company that has been authorized to issue bonds shall file with the commission verified statements showing the proceeds derived from the sale of the bonds and the detailed items to which the entire proceeds of the sale have been applied.

The Bay Shore Street Railway Company has been authorized to issue 150 shares of common stock of a par value of $100 each and $15,000 in notes, to be secured by first mortgage on its property. The proceeds of the sale of the stock and bonds shall be used for the payment of the construction and equipment of its line of street and interurban railway in the city of Green Bay, Wis.

The commission has granted the petition of the Oostburg Telephone Company for an increase in rates. The fact was brought out in the testimony that with the uniform monthly rate of $1 per telephone now charged by the company for all classes of subscribers, the income derived is insufficient to cover operating and maintenance expenses. From facts presented at the hearing it appears that the company is maintaining a full metallic 24-hour service with equipment superior to that maintained by the average company of the same size in the State. The engineer's valuation of the property was $6,455. The annual report of the company for the year ending June 30, 1909, shows a deficit of over $300, without any allowance being made for either depreciation or interest on the investment. The schedule as proposed by the company calls for a business rate of $2 per month, single-party, or $1.75 per month, two-party, and residence rate of $1.50 for single-party and $1.25 for two-party. The rural-service rate is to be $16 per annum, payable quarterly with a discount. It is also understood that the number of parties to a rural line is to be kept down to five wherever possible, which is in accordance with the desires of the commission. The uniform charge of 50 cents per month for extension telephones, which the company wished to put into effect, was not allowed by the commission. Because of the difference in service rendered, the same distinctions must be made here as are made between business and residence rates. The rates as allowed were 25 cents for residence and 50 cents for business telephones. On the basis of last year's report, and with fairly reliable data furnished by the manager of the company as to the probable number of subscribers which would fall in each class, the commission estimated the probable revenue under the new system of rates. Allowing 7 per cent for depreciation the net return would be approximately 3 per cent. While this is not considered an adequate return, it is expected that the future development of the business will increase the rate to a reasonable figure.

The commission has issued to the Sheboygan Light & Power Company a certificate of authority to issue $114,000 par value of bonds of the denomination of $1,000 each, to bear interest at the rate of 5 per cent per annum, and to mature July 1, 1933. These bonds are to be secured by a mortgage on the property of the company to the Mercantile Trust Company of New York City.

The special committee of the Legislature which was appointed to consider the conservation of the State's natural resources has completed its work. A portion of its investigation, which concerns the value of water rights, is in direct line with investigations now being carried on by the commission. While the majority report has not been completed, the minority report, while being apparently somewhat radical, outlines the general policy that must sooner or later be pursued. As the commission bases its rates entirely upon the question of cost, the question of the value of a water right is one that must be settled definitely, either by the State itself or by the State through the instigation of the commission.

The minority report places all water-powers, whether developed or not, at a total of over 1,000,000 hp under the direct control of the State. In every case a franchise must be obtained from the State before the power can be utilized, and the holders of the franchise must pay to the State a definite amount per annum for the franchise value of every horse-power repre-

sented and put to beneficial use during the year. The franchise value is to represent the difference in cost between the production of a horse-power by steam and the production of a horse-power by water-power at the same place, in like quantities and under like circumstances.

Whether the above definition of the franchise value is the best one or not is problematical; it is maintained that some uniform method of valuation must soon be adopted, and that this must be brought about ultimately through State control of water-rights.

New York Public Service Commission News.

The Public Service Commission of the First District has given its approval of the plan to construct a subway and elevated road along the Eastern Parkway, in Brooklyn, on the principle of assessing the cost on the property to be benefited. This is the first plan of this kind that has been approved since the law authorizing construction by assessment was adopted. The subway was requested by associations of property owners representing 52 per cent of all the property within a half mile on either side of the proposed line. The cost of the construction will be about $5,000,000.

The hearing of the commission ordered for last week, upon the reorganization plan of the Third Avenue Railroad, was adjourned until Feb. 3 owing to the absence of the counsel of the commission.

The commission received last week a delegation representing the Continuous Transit Securities Company, the concern which has proposed to build moving platforms under the streets of New York. The delegation was headed by Mr. Max E. Schmidt, president of the company, and included Mr. Robert Walker, president of the Rock Island Railroad Company; Mr. Stuyvesant Fish and a number of consulting engineers and counsel. The delegation insisted upon the construction of moving platforms under Broadway from Tenth to Forty-second streets, and under Thirty-fourth Street from Second to Ninth avenues. Plans for these routes have already been considered by the commission.

A report was filed in the Appellate Division of the Supreme Court last week by Messrs. William May Wright, Charles S. Foote and Rudolph Black, commissioners appointed to decide whether the plans for the proposed Lexington Avenue subway route should be modified so as to double-deck the line with the express and local trains on different levels. The commissioners say that in the testimony presented there was no argument of the slightest weight to prove that a double-deck subway would be less desirable or less economical than a subway with four tracks on the same level.

The Public Service Commission, Second District, has authorized the Rensselaer Falls Electric Light & Power Company, of Rensselaer Falls, N. Y., to increase its capital stock from $2,000 to $8,000, and to issue the capital stock to the amount of $6,000 for the purpose of paying indebtedness incurred in making additions and extensions to its plant. It is proposed to extend the lines of the company to DeKalb Junction. The commission has approved of the joint use by the Hudson Valley Railway Company of its cars and electric locomotives and the steam locomotives and freight cars of the Greenwich & Johnsonville railroad of the railroad track now built between the plant of the Standard Wall Paper Company, on the westerly side of the Hudson River in the County of Saratoga, and the plant of the Iroquois Paper Company, on the eastern side of the Hudson River in the County of Washington, proper rules for the safe operation of the track in question having been submitted and approved by the commission.

The commission will this week hold a hearing on the complaint of the light commissioners of the village of Theresa, Jefferson County, against the Hydro-Electric Power Company and Frederick L. Santway as to alleged unlawful furnishing of electricity for light and power in that village in competition with the municipal plant.

The Oswego River Power Transmission Company has been authorized to execute and deliver its mortgage in the sum of $100,000, securing 5 per cent 20-year bonds for like amount and to issue presently $60,000 of bonds to be sold at not less than 85. The proceeds of the bonds now authorized are to be used for the payment of outstanding obligations to the amount of $30,647.02 and for new construction work to the amount of $21,881. The new construction includes substation site at Baldwinsville, pole line Baldwinsville to Phoenix, completion of line Baldwinsville to Oswego, substation building at Fulton, reconstructing building at Phoenix and sundry equipment. The Genesee Fruit Company has been authorized to exercise rights and privileges in the furnishing of lights in the town of Madison, Madison County.

The complaint of the Buffalo General Electric Company against the Prudential Building Company has been dismissed. The complaint alleged that the Prudential Building Company was furnishing electric power for lighting purposes to St. Paul's Church, situated across the street from the Prudential Building Company, and that it was beyond the power and purpose of the Prudential Building Company to engage in the business of distributing and selling electricity and conveying it through the public streets; that the Prudential Building Company could not receive or exercise any franchise for that purpose or engage in that business, and that if it were allowed to exercise the powers of an electrical corporation it would be subject to the provisions of the public-service commissions law and would have been required to obtain the permission and approval of the commission.

Governor Hughes sent to the Senate last week the nomination of Mr. John N. Carlisle, of Watertown, N. Y., as a member of the Public Service Commission of the Second District, to fill the vacancy caused by the resignation of Mr. Thomas M. Osborne. Mr. Carlisle is a Democrat, and has been a practising lawyer in Watertown. At the same time Governor Hughes sent in the renominations of Mr. Martin S. Decker, of New Paltz, N. Y., as member of the Second District Commission, and of Mr. Milo R. Maltbie of New York, as members of the First District Commission. These appointments are for terms of five years. All of the nominations were confirmed by the Senate.

At the hearings in New York City last week conducted by the Legislative committee to determine whether or not telephone and telegraph companies should be placed under the supervision of the Public Service Commissions, Mr. B. G. Hubbell, president of the Federal Telephone & Telegraph Company, of Buffalo, testified that he believed that the Bell company had no valid franchise to operate a system in New York City. He based this opinion upon a decision of the Supreme Court rendered some time ago in a suit brought by the New York Electric Lines Telephone Company, in which it was held that a franchise granted by the old Board of Control, instead of the Board of Aldermen, was invalid. Mr. Hubbell says that the Bell franchise was issued in the same manner. He said that the independent telephone interests in the upper part of the State have been anxious to get into New York, but have been thwarted in their efforts. He also said that the present rates for telephone service could not be reduced, and the companies continue to earn enough to pay an adequate return for the money invested.

On the question of cable tolls, the committee heard Mr. G. G. Ward, general manager of the Commercial Cable Company, who testified that a written agreement had been entered into by the various cable companies in 1888 by which the rates for foreign messages were fixed at 25 cents a word. This was done, he said, after a rate war lasting 2½ years, during which time the companies had lost heavily. Mr. Ward said that when the Sherman anti-trust law went into effect the written agreements were all destroyed, but that the same agreements were now observed without there being any written contract. He said that only 1 per cent of the population were users of the cable, and that the rate could not be reduced without the companies losing money. He denied emphatically that there was

any sort of a combination or trust between the cable companies or the telegraph companies.

Mr. James A. Scrymser, president of the Mexican Telegraph Company and the Central & South American Cable Company, testified that his company paid no taxes in New York, and practically did no business in New York, because its messages were carried from the city to Coney Island on lines leased from the Commercial Cable Company. The committee thought that some taxes should be paid, and Mr. Scrymser was asked to produce his books at a future hearing.

Mr. Travis H. Whitney, secretary of the Public Service Commission of the First District, presented to the committee 56 written complaints which the commission had received from customers of the telephone and telegraph companies referring to excessive charges and inefficient service.

Massachusetts Legislative Notes.

The time for filing new legislation has expired under the rules of the General Court, except under suspension of the regulations. As intimated recently, the majority of the bills thus far introduced at Boston which are of interest to public-utility corporations are more or less related to electric transportation problems. The first important hearing on these matters was given this week by the committee on metropolitan affairs, when Chairman Crocker, of the Boston Transit Commission, discussed the recent report of the Railroad and Transit Commissions upon improvements needed in the Boston district. Mr. Crocker emphasized the need of immediate practical studies of electrification by the steam railroads in the Boston territory, and urged the General Court to issue a resolution calling upon the roads to report upon the matter early in the coming fall. In discussing the advantages of a tunnel between the North and South Stations at Boston, Mr. Crocker said that it is estimated that at present the switching of trains by steam costs $600,000 per year at Boston, and that this would be largely eliminated if electrified service were introduced, with the tunnel across the city to facilitate through movements of suburban trains. A bill has been introduced by petition of J. Nickerson requiring the electrification of all steam railway lines within the Boston metropolitan district. Another recently introduced bill provides that the Railroad Commission may prescribe the minimum price at which street railway bonds shall be sold, and may require companies to establish a sinking fund which will make up the difference between the face value of such bonds and the amount for which they were authorized, assuming that the issue is in excess of what was determined as properly necessary. A bill has been introduced to prohibit any more elevated railway construction in the city of Boston, and another measure which will shortly receive consideration at the hands of the committee on street railways is designed to permit all street and elevated railways in the State to carry baggage, express matter and freight on their lines, subject to the supervision of the Railroad Commission. Efforts are being made to have passed at the present session a resolution providing for an investigation and report by the Massachusetts Railroad and Boston Transit Commissions of the desirability of a physical conection between the Washington Street tunnel and the East Boston tunnel, in Boston. A bill just introduced permits street railways incorporated in the State to purchase, under control of the Railroad Commission, the property of foreign companies, connecting or intersecting, in the State. A bill has been introduced providing for the construction of a tunnel under Boston Harbor, with suitable terminals, by the Boston & Eastern Electric Railroad Company. A bill has also been framed which provides that poles and wires and the property of railroad corporations shall be taxed in the city or town where such property is located.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision of far-reaching significance to public utility companies in connection with an appeal of consumers for reductions in gas and electric rates at Beverly. The board sustains the present rates of the Beverly Gas & Electric Company, the respondent in the case, but the most significant part of the decision is the pronouncement of the commission in reference to the practice of devoting earnings to extensions and improvements. The board calls attention to the fact that such a practice was very general in the early days of public service corporations and was justified by the belief that as the capital charge was kept low and the amount per unit required for dividends decreased, low prices might be more certainly and quickly attained. The board takes the position that in the present advanced state of the art capital should not be provided out of income for extensions, but that after a payment of reasonable operating expenses, proper allowance for depreciation and emergencies, and a fair return upon the investment, surplus earnings should be used to facilitate further reductions in price.

The Beverly Gas & Electric Company began to supply electricity for lighting in 1888, and its prices have been modified and readjusted with the progress of the art as changes have been made by companies generally. At the date of the petition and for nearly two years before the maximum price for electricity was 15 cents per kw-hour, or 13.5 cents net. On July 1, 1908, the net rate was reduced to 12 cents. The company offers a lower rate for all electricity supplied for light in excess of 750 kw-hours per month and a differential scale of rates for motor service, beginning with a maximum of 10 cents per kw-hour.

"The income from the electric business is about 50 per cent greater than the gas income and the apparent profits about three times as large. Actual profits will only appear when a fair allowance for depreciation has been made, which at the present time is probably much greater on the electric than on the gas side of the business. These profits appear to be in part due to exceptional conditions likely to be materially changed in the near future. The relation of the station equipment rating to the maximum load recently attained has indicated the need of an immediate addition to the electric portion of the company's plant. The board claims that such changes in the interest of the company and the public should be made with sufficient liberality to meet the increased demands for a reasonable term of years. To do this will require a substantial expenditure, will probably displace much of the present equipment and, decreasing as it will for a time the present plant efficiency, is likely to increase temporarily the ratio of operating and investment cost to income. In the face of these facts it seems reasonable not to require any further reductions in the prices of gas and of electricity for commercial lighting, beyond those recently made, until the effect of this expenditure upon the company's business and profits shall receive some actual demonstration."

The concluding portion of the decision is quoted verbatim:

"Of the gross expenditure of the company, under its present management, for new construction, more than one-third, or upward of $180,000, has been obtained from earnings, and a large part of this in the more recent years. These figures indicate that, notwithstanding the numerous and fairly frequent reductions in price made by the company, the profits, in excess of dividends, which have been used to extend and improve its plant, have been larger than can readily be adjusted in view of the duty which the company owes to the public. In the early days of public service corporations such a policy was very general and justified by the belief that, as the capital charge was kept low and the amount per unit required for dividends decreased, low prices might be more certainly and quickly attained. If, however, the claim now made by some companies is to be conceded and the same return is to be allowed upon the value of all property employed for the public convenience from whatever source derived, no benefit accrues to the public from such accumulation. If the claim can be successfully made, it amounts in effect, if not in form, to a stock dividend. Nor is such a claim necessary to insure a continuance of the commercial prosperity of companies of this class.

"The public has a substantial interest in what remains of the net earnings above a fair dividend. No corporate interest properly viewed requires that such surplus be distributed to the stockholders or so invested as to impose new burdens upon consumers. A public service corporation exercising a virtual monopoly is bound to give its customers the best possible service at the lowest reasonable price, nor is the discharge of this duty to be measured merely by a comparison with the service and price prevailing elsewhere. After a payment of reasonable operating expenses, proper allowance for depreciation and emergencies, and a fair return upon the investment, surplus earnings should be used to facilitate further reductions in price. The board is convinced that this company no longer needs to continue, as heretofore, to provide capital for extensions out of income. As soon as the combined effect of the recent reductions and the necessary prospective expenditure and changes shall be realized, if profits shall then exceed dividends, as in some former years, it will be the plain duty of the management to make a further revision of existing rates. The question of the price for street lighting was not considered at the hearing, but since Dec. 1, 1909, the price of arc lighting for this purpose has been reduced from $90 to $85 per lamp per year." In view of the facts and considerations stated, the board voted to dismiss the petition.

STEAM PLANT COST OF EXTENSION, REVERE.

Parsons steam turbine (500 kw)	$12,354
Foundations, piping, etc.	4,550
Worthington 4-in. water piston meter	225
Two St. John steam meters, installed, 15-in. and 2-in.	645
	$17,774

ELECTRIC PLANT COST OF EXTENSION, REVERE.

Westinghouse 500-kw generator, direct-connected to turbine	$6,117
Additions and improvements to switchboard	2,500
Three 800-watt switchboard wattmeters	361
Seven oil switches, 200-amp triple-pole double-throw	304
Installation of above, with panels	222
Galvanized iron, air duct cooling devices for turbine	150
New switchboard instruments	264
Minor items	799
	$10,717

The Great Barrington Electric Light Company has petitioned the commission for authority to issue new stock to the amount of $80,000, at a price of $100 per share, to pay for floating indebtedness, new construction, extensions, and improvements, and to acquire title to water-power rights now leased.

The Lynn Gas & Electric Company has petitioned the board for authority to issue 1500 shares of new stock to the amount of $150,000 par value, at a price of $235 per share, to pay for additions to the plant and property.

The commission recently gave a hearing upon the petition of the Suburban Gas & Electric Company of Revere for approval of an issue of new capital stock to the amount of $169,500. President Charles H. Tenney represented the company and stated that since 1906, when the commission held a hearing upon a stock issue for the organization, the company has expended $238,150 upon its gas and electric plants. The depreciation has been $30,365 during the period, of which about $23,000 is chargeable to the electric plant. On account of various changes in the plant at Revere and the proceeds of a previous stock issue the total amount to be capitalized, including the estimated requirements for 1910, is $199,346. The principal additions made to the company's electrical equipment and system have represented a total of $83,565 in the period named. Certain detailed costs of construction and installation included in the items are representative of recent station investment charges.

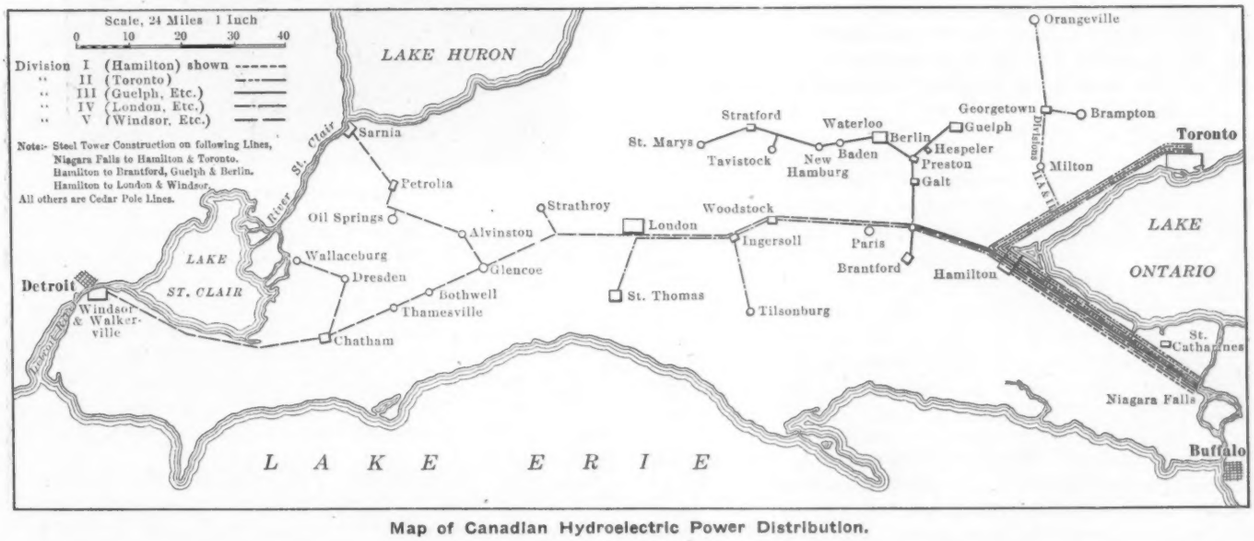
The board took the matter under advisement, there being no opposition.

Canadian Hydroelectric Commission News.

At the meeting of the water commissioners of London, Ont., on Jan. 21, Hon. Adam Beck, chairman of the Hydroelectric Commission, informed the commissioners that electric power would be ready from Niagara Falls for delivery to the municipal plant there on July 1 next.

A meeting of the electrical engineers of the various municipalities in the Niagara power union was held at Toronto on Jan. 25 for the purpose of fixing the rates to be charged by the municipalities to commercial users of power. The meeting was presided over by Mr. Robert A. Ross, consulting electrical engineer, of Montreal, and the different engineers will report direct to the various Councils the results of the decision of the meeting.

The numerous legal actions which have been besetting the operations of the commission almost since its inception, brought at the instance of various opposing interests, are being gradually cleared out of the way. On Jan. 25 the Divisional Court, without hearing argument, formally dismissed the appeal of Mr. Walter D. Beardmore from the decision of Chancellor Boyd. It will be remembered that mention of this action was made some time ago in this journal, that Mr. Beardmore was suing to restrain the corporation of Toronto from proceeding under its contract with the commission. At the trial the action was dismissed by the Chancellor, and his decision is now upheld by the higher court.



Map of Canadian Hydroelectric Power Distribution.

At the recent annual meeting of the Canadian Conservation Commission, at Ottawa, Hon. Adam Beck, chairman of the Ontario Hydroelectric Commission, delivered an address relating to the work of the Ontario Hydroelectric Commission.

In sketching the causes leading up to the institution of the commission by the Ontario Government, and the powers granted to the commission to control the rates charged to users of energy by the various municipalities entering into the scheme, he said the whole undertaking is a municipal enterprise conducted by the commission at the request of and as the appointed agent of the municipalities, and at their cost and risk. The plans now being worked out by the commission involved, he said, the largest energy transmission undertaking in the world, while the electric energy will be transmitted at the very high e.m.f. of 110,000 volts.

For Western Ontario and the Niagara peninsula the commission has made a contract with the Ontario Power Company to purchase not less than 8000 hp, and as much more as it requires up to 100,000 hp, for a term of 10 years, with provision for three extensions for additional periods of 10 years each, at the price of $9.40 per horse-power per annum up to 25,000 hp and $9 per horse-power per annum if the quantity taken exceeds 25,000 hp; the power is to be delivered to the commission at Niagara Falls at 120,000 volts, and the prices cover a 24-hour continuous service.

From Niagara Falls a 60,000-hp, double 110,000-volt transmission line will convey the energy to a controlling station at Dundas, now being built, from whence the line is continued east to Toronto without any intermediate station. From Dundas there will be a double line of the same size and voltage by way of Woodstock and London to St. Thomas, with local transformer stations at each point. A similar line proceeds from Dundas north and west, by way of Guelph, Preston, Berlin, Stratford, St. Mary's, and on to London, with local step-down stations at each place, the whole high-voltage line comprising 300 miles. At the local transformer stations the e.m.f. is reduced to 13,000 volts for the purpose of supplying energy, by local feeder or distribution lines, to different municipalities in the vicinity.

The whole southwest of Ontario, from Kingston to the Georgian Bay and south, will eventually be served, and the northeasterly part of Ontario, from North Bay to the St. Lawrence River, will be covered by a similar system which, in due time, will doubtless be established at the most appropriate generating points within the district.

The present arrangements of the commission include the supplying of 15 municipal corporations with their respective needs for energy up to a rate of approximately 27,000 hp over the lines described and now under construction. The rates payable by each municipality have been estimated as follows:

Municipality.	Amount hp.	Rate per hp per annum, 24-hour service.
Toronto	10,000	$18.10
London	5,000	23.50
Guelph	2,500	24.00
St. Thomas	1,500	26.50
Woodstock	1,200	23.00
Galt	1,200	22.00
Hamilton	1,000	17.50
Stratford	1,000	24.50
Berlin	1,000	24.00
Waterloo	685	24.50
Preston	600	23.50
St. Mary's	500	29.50
Hespeler	400	26.00
New Hamburg	250	29.50
Ingersoll	500	24.00

To these costs will be added the respective local distributing costs. Mr. Beck instituted a comparison between the cost of energy supplied by his commission and what it would be if derived from coal and steam plants. The exact quantity of power contracted for amounts to 27,350 hp, the cost of which averages about $22 per horse-power per annum, as against $60 per horse-power per year for power from a steam plant, for a 24-hour day, thus making a total saving of $1,039,300 per annum.

As to the probable future of the commission, Mr. Beck concluded by saying that if the present construction project, now nearing completion, realizes the expectations formed of it, the work begun would be completed in a manner calculated to meet the best interests of all the people.

AMERICAN ELECTRICAL ENGINEERS—IV.

H. St. Clair Putnam.

Henry St. Clair Putnam was born in Davenport, Ia., July, 1861. His paternal ancestors were Puritans who came to New England in 1634, and among whose descendants were Gen. Israel Putnam and Gen. Rufus Putnam, chief engineer officer of the Revolutionary army and a pioneer settler of Ohio. On the maternal side the American ancestry dates back to the early settlement of Virginia, the grandfather, Joseph Duncan, was an officer in the Kentucky Volunteers, who was presented with a sword by Congress for bravery in the War of 1812, and removing to Illinois subsequently served as its only representative in Congress and later became Governor of the State; his wife was a granddaughter of the Rev. James Caldwell, the famous "fighting parson" of the Revolution, whom Bret Harte has made the subject of a poem, and whose nephew was the distinguished ante-bellum statesman, John C. Calhoun.

Mr. Putnam attended the public schools at Davenport, and was the valedictorian of his class, both in the grammar and in the high school. He had early decided to become an engineer, but circumstances led him into the study and practice of law, which, however, he eventually abandoned in order to enter the junior year of the class of 1886 at the Rose Polytechnic Institute at Terre Haute, Ind., where he took the course in mechanical engineering, specializing in electricity. He was graduated with the degree of B. S., and received highest honors in his class, of which he was president and its valedictorian, and a special award for the highest standing in mathematics. He has since received from his alma mater the post-graduate degrees of M. S. and E. E.

H. St. Clair Putnam.

Soon after graduation Mr. Putnam entered the employ of the Thomson-Houston Electric Company, Lynn, Mass., where he took the expert course of the day. During the year he remained with the company he performed missions of a special character in New Hampshire, Maine, New York and Santiago, Cuba. In 1887 he was associated in the organization of the Thomson-Houston Carbon Company, of which he was one of the incorporators and a director, and became its treasurer and engineer. During a connection of four years with this company, he developed a very complete system of cost records and accounting, made a study of arc-light phenomena, developed a system of factory tests for carbons and placed their manufacture upon a systematic basis, both technically and com-

mercially. After the consolidation of the carbon manufacturing interests, Mr. Putnam remodeled the Brush carbon factory in Cleveland, and subsequently became manager of the American Carbon Works, at Noblesville, Ind. In 1895 he resigned from this company to go into consulting engineering work, which had always been his ultimate object, and from which he felt he had been too long diverted. He first opened offices in Chicago, removed afterward to Philadelphia, where he was associated with Mr. Horatio A. Foster, and later came to New York, where he subsequently entered into partnership with Mr. L. B. Stillwell.

Mr. Putnam has been closely associated professionally with many of the heavy electric traction enterprises in New York and vicinity. Among many others, he has had charge of the electrical portion of the work done by the firm for the New York, Westchester & Boston Railway, the New York & Queens County Railway, the Virginia Passenger & Power Company, the Allegheny Valley Street Railway, United Railway & Electric Company, Buffalo; Genesee & Rochester Railway, Erie Railroad Company, Lehigh Coal & Navigation Company, Norfolk & Southern Railway, Lehigh Traction Company and motor equipment and ventilation for the Interborough Rapid Transit Company. He has also made numerous special reports on engineering enterprises and on technical matters. He is the author of a number of papers on engineering subjects, among the titles being: "Alternating-Current Arc Lamps"; "The Water-Power of the Chicago Drainage Canal and Its Electrical Transmission to Chicago"; "Substitution of the Electric Motor for the Steam Locomotive in the Operation of Railways"; "The Electrical Haulage of Canal Boats"; "Conservation of Power Resources." By special invitation of President Roosevelt Mr. Putnam attended the conference of Governors of States held at the White House in 1908 to discuss the conservation of natural resources, at which he presented a paper upon the "Conservation of Power Resources."

Mr. Putnam is a member of the American Institute of Electrical Engineers, the American Geographical Society, the National Geographical Society, the National Conservation Association, and of the Lawyers' Club, Engineers' Club, Railway Club of New York and Cosmos Club of Washington, among others.

CURRENT NEWS AND NOTES.

Electrical Sterilization of Water Supply.—The matter of installing a plant for the electric sterilization of the city water supply is in contemplation by the City Council of Bristol, Tenn. A system similar to that used in Paris, France, though smaller, is discussed.

Electrical Energy in Tacoma.—Tacoma, Wash., is apparently one of the rather numerous places which have, or will have, "the cheapest electric power in the country." In a recent interview in Chicago, Mr. A. L. Sommers, secretary of the Chamber of Commerce and Board of Trade of Tacoma, is reported to have said: "Tacoma owns its electric power plant and is expending $2,000,000 in perfecting it. This will give Tacoma the cheapest electric power in the country."

Examination for Junior Railway Engineer.—The New York State Civil Service Commission will hold an examination on Feb. 26 for junior railway engineer. Applications must be filed with the State Civil Service Commission, Albany, N. Y., on or before noon, Feb. 19. The salary ranges from $1,201 to $1,800 per annum, and the duties are to inspect power houses and equipment of subway, elevated and street railways, and of electric companies in New York City. Candidates must be graduate electrical or mechanical engineers and have at least one year's practical mechanical or electrical experience, or offer four years' practical mechanical or electrical experience with railroad, street railroad or electric companies. Subjects of examination and relative weights: Theoretical and practical questions relating to the construction and operation of power-house and railway equipment; measurements; standards, and other pertinent subjects, 5; experience and personal qualifications, 3; education, 2.

Wireless Telegraphy at Panama.—Wireless telegraphy has rendered very satisfactory service in the transaction of business in connection with the quarry and rock-crusher operations along the canal. The ground connection is made by means of 16 copper plates, each 3 ft. x 6 ft. in size, sunk in the bed of the Porto Bello reservoir. The mast will hold a 320-ft. circle aerial. The station is equipped with an improved type of DeForest apparatus, including a duplicate set of tuners, which not only furnishes an instrument in reserve, but also permits the transmission of messages from both instruments at the same time, providing the radius in which one operator is working is outside the radius of the other.

"Main 13" and "Main O."—Calls for "Main 13"—the number by which the Chicago Telephone Company gives free service from any of its telephones in the city to the nearest police station—were 12,602 more numerous in 1909 than in the previous year. Under its franchise the company makes no charge for giving connection with "Main 13." The number does not represent a particular telephone, but is a designation used to identify the instrument at the police station located in the territory of the telephone exchange with which the subscriber is connected. There is another free telephone, "Main O," which connects the subscriber with the fire-alarm telegraph office and is to be used only in case of fires. This was used 986 more times in 1909 than in 1908. All told, the company transmitted 8825 free fire calls in 1909 and 62,005 free police calls.

Electrically Driven Rolling Mill.—Some interesting results have recently been obtained in the working of the new 28-in. cogging mill at the Cleveland Wire Works of Messrs. Dorman, Long & Company, of Middlesborough, England. This mill is arranged for the Ilgner motor-generator system of driving, and the electrical equipment has been designed and built by the British Thomson-Houston Company. During a night shift of 12 hours 92 ingots, 14 in. x 12 in., were cogged down to both 6-in. and 5-in. billets in 4 hours and 41 minutes. The total weight cogged was 105 tons, the average output of the mill thus being over 22 tons per hour for a continuous period of nearly 4¾ hours. With this mill an ingot can be cogged down to a 5-in. billet in 2¼ minutes. The normal maximum speed for which the plant was designed is 70 r.p.m., but the electrical portion of the equipment makes it possible to work at a rate considerably in excess of the average. It is claimed that this installation represents the fastest cogging plant in the northern part of England.

Terminal Electrification Problem in Chicago.—The special committee appointed by the Chicago Association of Commerce to study the subject of smoke abatement and the electrification of railroad terminals has resumed its sessions. The committee was appointed last fall and consists of Messrs. John M. Ewen, engineer and contractor, chairman; W. L. Abbott, Commonwealth Edison Company; Bion J. Arnold, consulting engineer; Paul P. Bird, city smoke inspector; W. F. N. Goss, dean of College of Engineering, University of Illinois; Charles E. Merriam, professor in University of Chicago and Alderman of Seventh Ward; W. A. Gardner, vice-president, Chicago & Northwestern Railway Company; A. Bement, consulting engineer, and William B. Jackson, consulting engineer. The committee has arranged that Messrs. Bird, Goss and Bement submit data on fuels that may be used as substitutes for coal in locomotive use. Further, it has decided that Mr. Arnold shall report on the cost of electrification of railroad terminals.

Engineering Society of Wisconsin.—The second annual meeting of the Engineering Society of Wisconsin will be held at Milwaukee on Feb. 23, 24 and 25. The secretary of the society is Mr. W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Paris Cablegrams.—On account of the severe storms of the past two weeks practically all communications by telephone and telegraph have been cut off between Paris and London. Reports from Paris intended for London are being sent to New York and retransmitted to London.

Iowa Electrical Show.—An electrical show will be held in Sioux City, Ia., April 20 to 24, in conjunction with and under the auspices of the Iowa Electrical Association, which will hold its convention in the same city April 20 and 21. Mr. W. N. Keiser, of Des Moines, is secretary of the association.

Underground Transmission in Sacramento.—It has been announced that the Great Western Power Company will place its transmission circuits underground in Sacramento, Cal. A substation will be erected at Eighth and R streets for distributing energy to lamps and motors throughout the business district of the city.

Meeting of New York Section, I. E. S.—A paper entitled "School-Room Lighting," by Messrs. Geo. W. Knight and A. J. Marshall, will be presented at a meeting of the New York Section of the Illuminating Engineering Society, to be held on Feb. 10. A problem in storeroom lighting will also be presented for solution by the members.

Monticello, Ind., Water-Power Plant.—No trouble has been experienced so far this winter from high water and ice at the water-power plant of the Tippecanoe Electric & Power Company, at Monticello, Ind. An item to the contrary effect in the construction news of the *Electrical World* of Jan. 27 was based on incorrect information. The plant was described and illustrated in the *Electrical World* of Oct. 21 last, and the flood gates there mentioned have been found amply sufficient to protect the installation.

Water-Powers of Canada.—In his inaugural address at the first annual meeting at Ottawa, Canada, of the Commission of Conservation of the Natural Resources of Canada, recently constituted by the Dominion Government, President Clifford Sifton stated that it was roughly estimated that the water-powers of Canada capable of possible development amounted to 17,000,000 hp, and probably very much greater. The present development was only about 511,000 hp. The object in the creation of this commission by the Government is the conservation of Canadian natural wealth of water, mine and forest, to be accomplished by study, investigation and by advice, the commission being in no sense executive or administrative.

Reduction in Denver Central-Station Meter Rates.—The Denver Gas & Electric Company has reduced its meter rates from 9 cents to 8 cents, net, per kw-hour. Under the franchise granted the company several years ago, provision is made for the return to the city treasury of receipts over a certain average charge for the past year. For the years 1910 and 1911 the company is required to return to the treasury of the city "all that portion of the gross receipts from electricity sold for lighting purposes in excess of an average of 6 11/10 per kw-hour sold." This applies to meter rates and to "readiness-to-serve" rates combined, and it has been the policy of the company to keep the rates so low that the consumer rather than the city treasury will be the beneficary.

Water-Powers of Ontario.—The new Porcupine gold fields in Northern Ontario, which have lately come into considerable prominence through the discovery of gold in the region, are situated about 150 miles due north of Sudbury, Ont., Can., and 40 miles south of the junction of the Temiskaming & Northern Ontario Railway with the National Transcontinental Railway at Cochrane, Ont., Can. The Mettagamia River, which flows within a few miles of several of the best gold discoveries yet reported, has numerous water-powers, two of which are capable of supplying from 5000 hp to 7000 hp. Within 15 miles of the mining camp no less than 15,000 hp can be developed, and on the High Falls on the Frederick House River there is a fall of 50 ft. capable of producing probably 5000 hp.

Baltimore Street Lighting.—Superintendent Robert J. McCuen, of the Department of Lamps and Lighting, of Baltimore, Md., will ask for bids on municipal lighting six months in advance of expiration of contracts, with a view of getting reduced rates. Baltimore has 2560 arc lights, and the price now paid is $67.49 a year. Mr. McCuen contends that the price should be little if any in excess of $50. It is threatened that if the new bids greatly exceed this figure the city will establish a municipal lighting plant, granting the company a contract for one year from next September when the present contract expires, by which time the city would have a plant of its own in good working order. For several years the city has had an enabling act authorizing it to borrow $1,350,000 for the establishing of a lighting plant of its own and the building formerly occupied by the Baltimore Sanitary & Contracting Company, at Port Covington, which is now owned by the municipality, is said to be an ideal one for the purpose.

New York State Water-Powers.—In the annual report of the New York State Water Supply Commission submitted to Governor Hughes, it is stated that no less than 1,500,000 hp can be developed on the interior streams of the State without counting Niagara and the St. Lawrence rivers. Four great reservoir projects of water storage for power development and flood control have been located, surveyed, mapped and described. These are the Sacandaga and Schroon lake reservoirs on the Hudson drainage, the Portage reservoir on the Genesee and the Tupper Lake reservoir on the Raquette. The commission favors an amendment to the State constitution with reference to the use of State lands for reservoirs and to permit the issue of water-storage bonds to provide for storage-reservoir construction, not to exceed $20,000,000. A bill also accompanied the report embodying the commission's plan of operation for a general and systematic development of the water resources of the State.

Minneapolis to Have an Electrical Show.—The recently incorporated Northwestern Electrical Show Association, Security Bank Building, Minneapolis, Minn., will hold an electrical show at the Armory in Minneapolis beginning March 26 and ending April 2. The officers of the company are: President, Mr. F. G. Dunstin, superintendent of city electrical department; vice-president, Mr. George J. Cadwell, Cadwell & Brown Company; secretary, Mr. C. D. Wilkinson, Western Electric Company; treasurer, Mr. A. W. Leonard, Minneapolis General Electric Company. In addition to these gentlemen, Messrs. W. D. McDonald, Westinghouse Electric & Manufacturing Company; W. F. Smith, General Electric Company, and J. L. Barnard, Bryan-Marsh Company, are directors. It is the purpose of the company to give a thoroughly representative electrical show. About 15,000 sq. ft. of booth space is available, and the standard booth will contain about 150 sq. ft. An elaborate scheme of decoration and illumination is in preparation, and both alternating current and direct current will be available for exhibitors. There will be good music, and it is believed that the attendance not only from the Twin Cities, but from the State of Minnesota and the Dakotas, will be large. The annual convention of the Minnesota Electrical Association will be held in the week of the show. Mr. Cadwell, vice-president of the company, was at the recent Chicago Electrical Show and secured a number of exhibitors. It is said that the larger electrical manufacturing companies have agreed to take part in the show.

Compulsory Guard Rails.—The officers of the Central Indiana Lighting Company, Alexandria, Ind., are being prosecuted under a State law for failing to have a guard rail installed about a large flywheel in their plant, and on an additional charge of not having the boilers properly inspected.

Meter Test Officer.—The new municipal administration of Fort Wayne, Ind., is planning to create the office of electric meter tester. A competent meter tester and assistants will be appointed to test all the meters used by the electric service companies, including the municipal light service.

Hornell's Electric Glare.—Many persons in Hornell, N. Y., thought the central portion of the city was on fire a few nights ago and telephoned anxious inquiries. An unusual combination of frost and exhaust steam in the business district reflected the light of the electric street lamps and signs in such a manner that observers in the outskirts fancied that they saw the reflection of a great fire.

Safety in Travel by Rail.—The signal engineer of the Lackawanna Railroad, Mr. M. E. Smith, states that, by reason of the electromagnetic block system of signals installed, there has never been a head-on collision on the road and no rear-end collision for years. In 10 years not one passenger has been killed; during this time the road has carried 193,787,224 passengers, each riding an average of 19.1 miles.

Wiring in the Rocky Mountain Region.—The Rocky Mountain Fire Underwriters' Association, after a correspondence and personal efforts with construction companies covering the past year, has now secured a wiring standard in the larger towns of its district. A majority of the newer mercantile buildings in Albuquerque, Roswell and Las Vegas, N. M., are now being wired in conduit throughout.

Iowa Electrical Association.—The tenth annual convention of the Iowa Electrical Association will be held at Sioux City, Ia., on April 20 and 21. The Iowa Street & Interurban Railway Association will hold its annual convention at the same place during the same week, and an electrical exhibition will be given under the auspices of the two associations from April 20 to 23. Mr. O. E. Brownell, of Lake City, is president of the Iowa Electrical Association and Mr. W. N. Keiser, of the Des Moines Electric Company, is secretary.

Preservative Treatment of Poles and Cross-Arms.—A committee of the National Electric Light Association, with Mr. W. K. Vanderpoel as chairman, is now engaged in an investigation of the subject of preservative treatment of poles and cross-arms. In order to gather desirable data, a circular of inquiry has been sent to members of the National Electric Light Association containing 60 questions, answers to which are requested. Under the head of poles, information is asked as to the number of poles, annual renewals, sizes, method of setting, etc. Another section is devoted to cross-arms, and more than half the questions relate to painting and preservation, including costs and experience with various preservative materials.

Motor-Driven Team-Haulage Cableway.—For the purpose of assisting teams of horses in hauling heavy loads up a grade varying from 15 per cent to 20 per cent for 2000 ft. in Seattle, Wash., a team cableway, driven by electric motors, has been placed in service. Use is made of a ¾-in. steel cable which is capable of hauling simultaneously six 3-ton loads with the wagons. The time consumed in transit is about 10 minutes. As actually operated, a rope is connected between the cable and the axle of the wagon which is steered by the horses in the regular manner, the speed being such that the horses walk in front of the wagon without attempting to pull the load. The charges are based upon the number of horses assisted, rather than upon the weight hauled, the rate being 30 cents per horse. The conveying was designed by the W. Montelius Price Company, Seattle.

Telephonic Correspondence.—According to a plan put into effect in London on Jan. 8, the substance of any letter addressed through the Central Telegraph Office, marked "For telephone delivery on Sunday" and containing 3 d. in stamps for every 30 words, will be forwarded by telephone to the address indicated when mailed too late for delivery on Saturday. This plan, which is rendered desirable by reason of the lack of regular mail delivery on Sunday, can readily be carried out because the telephone and telegraph lines, as well as the mails, are under the charge of the British Postmaster-General.

The Eskimo and the Telephone.—In the course of a lecture at the Museum of Natural History, New York, Jan. 20, on the Peary North Pole expedition, Prof. D. B. McMillan, who was one of the party, told an amusing story of the efforts of an Eskimo to construct a telephone line. During a stop at a hut which had been occupied by the Greely expedition an Eskimo found a long piece of wire. Never having seen wire he asked Professor McMillan what it was and what it was for. He was told that the white men strung wire like it on poles stuck in the ground and by talking to an instrument at one end the voice could be heard at the other end. Next morning the Eskimo was missing. After a search he was found carrying on some telephone experiments of his own. He had stuck some sticks in the ground and hung his wire on them. He held one end of the wire up to his mouth and talked to it at the top of his voice. Then he ran as fast as he could to the other end and held the wire to his ear expecting to hear his own words repeated. When he failed to hear any sounds the expression on his face clearly indicated what he thought of his white friend.

Chicago N. E. L. A. Branch.—At the regular monthly meeting of the Commonwealth Edison Branch of the National Electric Light Association, in Chicago, on Jan. 25, Mr. John C. Manley presiding, Mr. B. G. Jamieson, assistant to the electrical engineer of the Commonwealth Company, gave a talk on the 60-cycle, 12,000-volt transmission lines of the company in Chicago, describing both the underground and the overhead construction. Messrs. George H. Jones, D. W. Roper and others took part in the discussion. Mr. H. E. Addenbrooke, assistant to the auditor of the company, read a paper on "Accounting," giving a general account of the accounting methods of handling the various features of the company's business. The serious features on the program were interspersed with various entertainment features, both Commonwealth Edison men and professionals taking part. On Friday evening, Jan. 28, the members of the branch were the guests of the Chicago Electrical Show and listened to the lectures of Messrs. M. M. Wood and William Bruce Leffingwell in the assembly room at the south end of the Coliseum.

Electrical Section of Western Society of Engineers.—New officers for the Electrical Section of the Western Society of Engineers of Chicago were elected at the meeting on Jan. 26, as follows: Chairman, Mr. George H. Lukes, North Shore Electric Company; vice-chairman, Mr. G. T. Seely, South Side Elevated Railroad Company; member of executive committee, Prof. P. B. Woodworth, Lewis Institute. The hold-over members of the executive committee are Mr. W. L. Abbott, Commonwealth Edison Company, and Mr. E. N. Lake, Board of Supervising Engineers, Chicago Traction. It was decided to hold the monthly meetings of the section on the fourth Wednesday of each month instead of the second Friday as heretofore. At the meeting of Jan. 26, which was held jointly with the Chicago Section of the American Institute of Electrical Engineers, Mr. Lee Campbell, of the Automatic Electric Company, gave an illustrated address on "Recent Developments in Automatic Telephony." At the next meeting, to be held on Feb. 23, Mr. E. N. Lake is scheduled to read a paper entitled "Some Proposed Improvements in Underground Conduit Construction." This also will be a joint meeting with the local section of the Institute.

Alternating-Current Pie.—B. L. T., the diverting linotype operator for the Chicago *Daily Tribune,* announces the discovery of a new creation, "alternating-current pie"—first a currant, then a fly. Burbank has no claim to this production, and no fletcherization is necessary.

Travel in London.—According to the report of the London Traffic Branch of the Board of Trade, there were 1,377,680,000 railway, tramway and omnibus passengers during 1909. Estimating the population of Greater London at 7,537,000, there were 188 journeys per population. Throughout the district there are 688 miles of railways and 311 miles of tramways.

Telephone Boors Menaced.—The Copenhagen telephone exchange has installed phonographs in order to check the abuse of operators by boorish subscribers. Shortly after the new system was put into use, some of the worst offenders were summoned to the directors' office and when they denied the charge, were convicted by the exact repetition of their own voices.

Glasgow Exhibit of Electrical and Gas Utilities.—Initial steps have been taken to make arrangements for holding in Glasgow, Scotland, an exhibition of electrical and gas appliances for domestic service. The proposed committee on arrangements will consist of 15 members, six from each of the municipal gas and electric committees and three from the sub-committee on air purification.

Electricity in Mines.—At a recent miners' convention in Indianapolis the opposition of mine workers to electric power, the introduction of which they consider against their interests, was manifested in a resolution declaring that the use of electricity in mines is hazardous, as the leakage from poorly insulated wires has a tendency to ignite mine gases and frequently causes explosions.

Oklahoma Public Utilities Association.—The executive committee of the Oklahoma Public Utilities Association will meet in Guthrie on Feb. 9 and make arrangements for the forthcoming annual convention of the association. This convention will be held in Sapulpa, Okla., in May, but the exact date has not been fixed as yet. Mr. Galen Crow, manager of the Guthrie Light & Power Company, is the secretary of the association.

Electric Heating and Cooking.—The Carnegie Library of Pittsburgh has issued in pamphlet form a list of books and magazine articles on the subject of electric heating and cooking. The references are mainly to practical domestic applications of electricity, no attention being given to electric welding, electric furnaces or the theory of thermo-electricity. The list, which includes articles up to Dec. 1, 1909, contains almost 100 references and cross-references.

Electric Lighting in a Mill Town.—The change from the steam to the electric drive in several of the larger mills in Greenville, S. C., has been carried to the furthest limit by the Monaghan cotton mills, which has not only supplied the mill village with electric street lights, but has installed the incandescent light in the homes of all of the several hundred operatives, at a nominal monthly rate. The electric light is very popular with the mill people.

Thurston Memorial Tablet.—The regular monthly meeting of the American Society of Mechanical Engineers on Feb. 8 will be devoted to the dedication of a bronze memorial tablet to the late Dr. R. H. Thurston, who was the first president of the society. The tablet, which is a replica of one presented to Sibley College, Cornell University, is the work of Mr. Herman H. McNiel, a former student of Professor Thurston. At the meeting addresses will be delivered upon Dr. Thurston and his lifework.

Philadelphia Electrical Exhibition.—A special feature of the electrical exhibition to be held in the First Regiment Armory, Philadelphia, from Feb. 14 to 26, will be the illumination, both interior and exterior. The Armory will be elaborately decorated with electric lamps. Especially constructed cars bearing lighted and decorated floats will be run over all local and suburban lines of the Rapid Transit Company. North Broad Street, from City Hall to Callowhill Street, will be brilliantly lighted, while the City Hall itself will be festooned with streamers of incandescent lamps.

Central Colorado Transmission Lines.—In the article which appeared Jan. 27 on the transmission lines of the Central Colorado Power Company a table was given showing the elastic limit and tensile strength of the seven-strand steel guard or ground wire used on those transmission lines. The elastic limit is given in that article as 37,500 lb. per square inch and the tensile strength 62,000 lb. Since publishing this table information has been received of tests which indicate greater strength than this. Three samples were sent to the Colorado College for test. The average of these three samples, which were very uniform, is 88,000 lb. per square inch tensile strength. If the elastic limit is taken as 60 per cent, the elastic limit would be about 52,700 lb.

Electric Power in Southern Cotton Mills.—A State report shows that 26 per cent of the 312 cotton mills of North Carolina are now using electricity solely as motive power. This revolution in the matter of motive power has been achieved practically within the last 10 years, especially among the new mills, and probably 60 per cent of the existing mills have been completed during the 10-year period referred to. Furthermore, it is found by comparison of figures that 35 per cent of the cotton manufacturing plants use electricity either entirely or in part. The indications are that this percentage will gradually increase, until practically every up-to-date mill in the South will be electrically driven, unless it is so situated that inaccessibility to electric supply will prevent the change.

Electrical Engineering at Notre Dame University.—Sixty of the advanced students of electrical and mechanical engineering of Notre Dame University spent last week in Chicago visiting the Electrical Show and inspecting the large manufacturing and power plants of Chicago. They also stopped at Gary to inspect the steel mills. The party was accompanied by the head professors of mechanical and electrical engineering, and during the tour each student was required to take some special subject and study it out in detail for presentation at a meeting of the engineering society, as well as for publication in the university technical magazine. The engineering faculty this year has induced Mr. L. B. Andrus, superintendent of the Indiana & Michigan Electric Company, to give a series of general lectures during the course of the year, dealing with practical problems which he has successfully mastered in his many years of experience in the installation of large power houses in northern Indiana and southern Michigan, along the valley of the St. Joseph River. Mr. Andrus began the work with a system of blue prints giving data of costs and efficiency of maintenance of power plants, and after each student had followed the work through a series of curves, general lectures followed. The subjects of the lectures for the second semester are as follows: The correlative relation of theoretical and practical subjects and their prominence in steam engineering, showing the importance of theoretical training and calling attention to practical subjects outside of theory which have to be taken into consideration with theory, working out the final economic analysis and also showing the necessity of moral stability in enforcing the proper interpretation of results; construction and analysis of the temperature-entropy diagram; economical possibilities in prime-mover operation; economics of steam-plant auxiliaries; economics of boiler evaporation and purchase of coal; efficiency in fuel burning; economics of labor costs and influence of load factor in central-station practice.

GENERATING STATION OF THE SAYRE ELECTRIC COMPANY.

Application of the Exhaust Steam Turbine in a Small Plant Supplying a Mixed Railway and Lighting Service.

THE Sayre Electric Company supplies electricity for all purposes to the municipalities of Waverly, South Waverly, Sayre and Athens; the first place being in New York and the other three in Pennsylvania. The combined population served aggregates 20,000, located in the broad, fertile valley created by the Susquehanna and Chemung rivers directly upon the boundary line of the two States. The plant, located at Sayre, was entirely rebuilt about July, 1908, when it passed into control of Messrs. Meikleham & Dinsmore, of New York, and possesses the distinction of being one of the very first, if not the first, small central stations to be equipped with an exhaust steam turbine operating in connection with reciprocating engines.

The generating station is located on Shepherd Creek, a very steady stream rising in Cayuta Lake and emptying into the Susquehanna River just below the station. The main lines of the Lehigh Valley, Erie and Lackawanna railroads pass quite closely to the plant and advantage is taken of the location for advertising both the company and the town in large electric signs attached to the smoke stacks and on the side of the building. Water for condensing and feed-water purposes is obtained from the stream and is found to be exceptionally free from scale-forming ingredients. In the spring it is planned to construct a small concrete dam and forebay adjoining the station as to conserve the water supply, and by increasing the height of the stream at that point decrease the lift from the creek to the condenser. The proximity of so many large coal-bearing lines makes it an easy matter for the station to obtain steady supplies of fuel. That used at present consists of a mixture of Bernice screenings brought over the Lehigh Valley Railroad and bituminous slack brought over the Buffalo, Rochester & Pittsburgh road. The former fuel costs on the average $1.45 per ton and the latter $2.10. It is dumped from the railroad cars into a hopper and passes thence into a conveyor to an overhead bin arrangement capable of storing sufficient fuel for a week's run. The conveyor system, which is of the gravity-bucket type, is driven by a 15-hp, 220-volt, 60-cycle, three-phase motor. The bunkers are equipped with 10 duplex cut-off coal valves complete with levers and links for operation from the boiler-room floor. Under normal conditions the system is capable of delivering 20 tons per hour. From the bins the fuel passes to a traveling weighing car, and thence through chutes to the stokers or boiler-room floor, as the case may be.

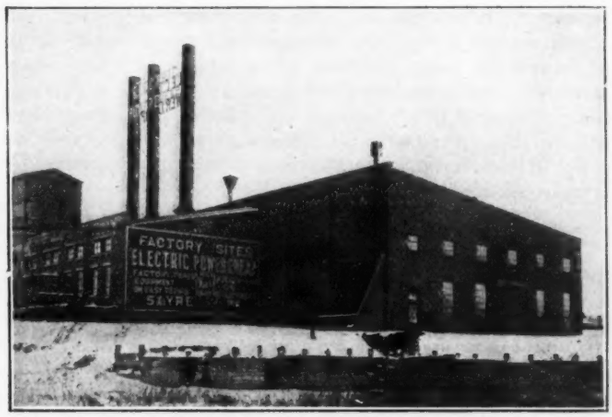


Fig. 1—View of Station from Railroad.

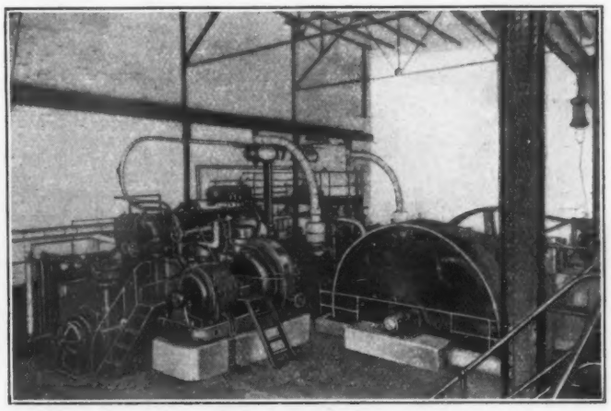


Fig. 3—Interior View of Sayre Electric Company's Station.

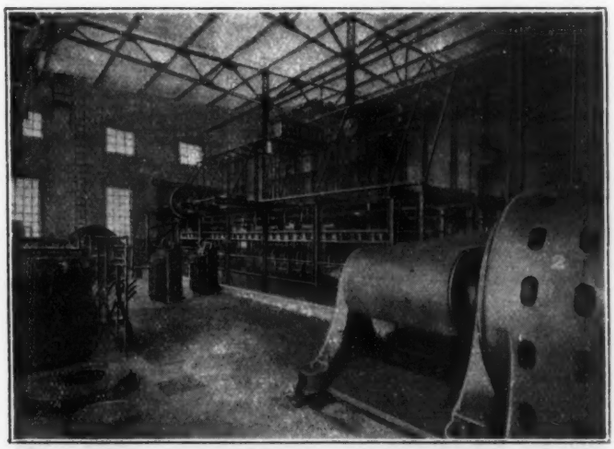


Fig 2—Rear of Switchboard, Arc Transformers and Main Generator.

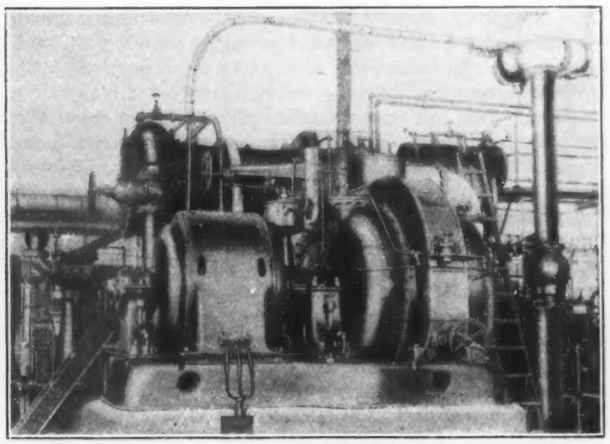


Fig. 4—Low-Pressure Turbine.

The boiler-room equipment comprises 900 hp in Stirling water-tube boilers, two boilers being equipped with Jones underfeed stokers and a third with McClave shaking grates. Forced draft from a Sturtevant steam-driven fan is employed under all of the furnaces, and in the furnace of the hand-fired boiler two steam jets are employed between the upper and lower arches over the furnace to keep the air between them in circulation, since otherwise the lower arch would be in danger of being burned out. The average steam pressure carried is 150 lb. Recent tests showed boiler economic results as follows:

Water evaporated per pound of coal	6.76 lb.
Equivalent evaporation from and at 212 deg. per pound of coal	8.00 "
Water evaporation per square foot of heating surface per hour	3.76 "

The steam piping from the boiler-room to the engines in the

generator-room is very short so that the losses here are a minimum. Automatic valves are fitted to the boilers so that in case of mishap in the engine-room steam is shut off immediately.

The generator-room equipment comprises two 300-kw, 2300-volt, three-phase, 60-cycle General Electric belted generators; one 260-kw, 500-volt, direct-current Keystone belted generator; one 300-kw motor-generator set, made up of a 2300-volt synchronous motor and a 600-volt direct-current generator; one 300-kw exhaust-steam turbo-alternator; two 25-kw exciter sets, one motor-driven and the other steam-driven, and four 50-light

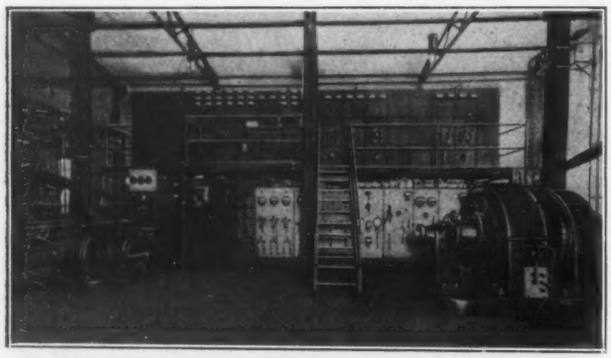


Fig. 5—Switchboard and Motor Generator Sets.

constant-current, air-cooled transformers. The turbine is arranged so that it may take exhaust steam from the three reciprocating engines. The exhaust from two units, however, is all that is required to load the low-pressure machine. The latter is of the General Electric horizontal type, and when operating at a gage pressure of 1 lb. at the throttle and against not more than 2 in. absolute back pressure in the exhaust chamber of the turbine, requires 46 lb. of steam at full load per kw-hour of energy delivered.

The low-pressure turbine unit is equipped with an Alberger surface condenser designed to maintain a vacuum of 2.5 in. absolute when condensing steam at the rate of 46 lb. per kw-hour of turbine output based on a barometer pressure of 30 in. and with injection water at 70 deg. Fahr. When condensing at the rate of 20,000 lb. of steam per hour the condenser maintains a vacuum of 4 in. and when condensing at the rates of 28,000 lb. and 32,000 lb. vacuums of 6 in. and 8 in., respectively. The circulating, condensation and vacuum pumps are driven from a single induction motor, the vacuum pump by silent-chain drive from the shaft between the motor and the circulating pump. The latter pump is supplied from the creek, 80 ft. away, which at low water is over 14 ft. below the engine-room floor. The water of condensation is delivered direct from the condensation pump to a Cochrane open feed-water heater 16 ft. above the engine-room floor and 14 ft. from the pump. As will be noted from the general view of the generator-room, the steam units are very compactly arranged in one corner of the room so that the exhaust connections from the two reciprocating engines to the low-pressure turbine are quite short. Should it be desirable to cut out the low-pressure unit, the reciprocating units may be connected directly with the condenser.

As indicative of the performance of the station under operating conditions with the exhaust-steam turbine unit in use, the results of a test made late in November are of interest. The fuel used under the boilers was a mixture of six parts of Bernice screenings and one part of soft coal. The average pressure carried on the boilers was 147 lb., the vacuum 28.28 in.; the barometer reading 29.29 in. and the pressure at the inlet to the exhaust turbine 10.91 lb. absolute. The electrical load carried by one generator was 3510 kw-hours, that of the low-pressure turbine unit was 2940 kw-hours and 900 kw-hours was carried by the direct-current machine. Of this total load 203 kw-hours were used by the exciter, 2110 kw-hours by the motor-generator set, 650 kw-hours by the power house, 430 kw-hours went to Athens, 980 kw-hours to Sayre, 1200 kw-hours to Waverly, 1048 kw-hours to the arc circuits, and 148 kw-hours to station lighting, or a total of 6769 kw-hours was accounted for.

At the start of the test the alternator, driven by a 20 x 42 Allis-Chalmers engine, the low-pressure turbine set and the motor-generator set were placed in operation. The hand-fired boiler was under steam and one of the other boilers was banked and one was out of service. The engine driving the direct-current generator, a 26-in. x 48-in. Bates Corliss, was warmed up at 4:30 p. m. and placed in service at 4:55 to carry the railway load. The motor-generator set, which up to that time carried the railway load, was cut out of service at 4:55. The banked boiler was started up at 4 p. m. and placed in service at 5 p. m. The arc lamps were lighted at 5:11, and the engine driving the railway generator was shut down at 10:45 p. m. and the motor-generator set again started. The boiler fitted with the stoker was shut down at 11:30 p. m. At 1 a. m. the arc lamps in South Waverly and Athens were extinguished and the other lamps were cut out at 6:35 a. m.

The results of the 24-hour commercial test under the conditions as specified above were as follows:

Total pounds of coal burned	41,701
Total pounds of water evaporated	273,964
Pounds of water evaporated per pound of coal	6.57
Total pounds of water received from condenser	192,575
Total kw-hours generated	7,350
Actual pounds of steam used per kw-hour generated, including that taken by auxiliaries	37.27
Pounds of steam used by auxiliaries per kw-hour	11.07
Net steam consumption of main units per kw-hour generated	26.20
Water used by auxiliaries	80,754
Coal used per kw-hour	5.67
Exhaust steam used by turbine per kw-hour generated	65.50

The switchboard is located in the center of the room and is of the double-deck type; all of the alternating-current apparatus and circuits being controlled from the upper board and the direct-current apparatus and lines from the lower board. A Tirrill regulator is connected to the circuits of the 2300-volt machines and also regulates the potential on the Waverly circuit. The Sayre and Athens lines have motor-driven feeder regulators designed for circuits with rapidly fluctuating loads, or where the source of potential is unsteady due to drags and surges of the line, starting up of induction motors or when a

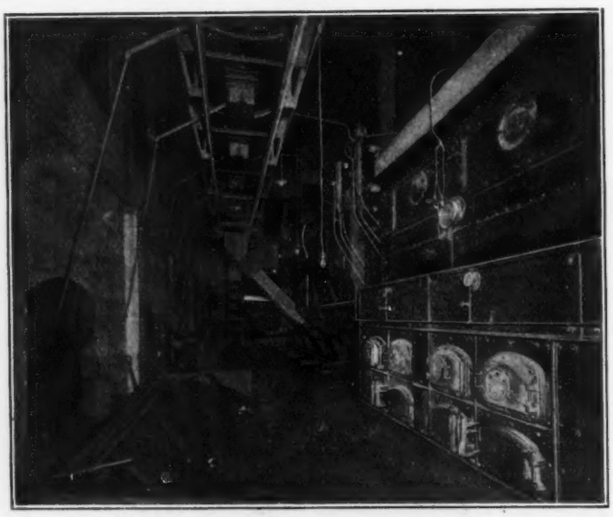


Fig. 6—Boiler Room Equipment.

railway load is taken from the same system. The regulators are attached to one phase of the system. The feeders are all overhead and three circuits, one for each town, suffice; Waverly and South Waverly being fed from the same circuit. There are in addition to the railway circuits five arc circuits.

The company supplies the Waverly, Sayre & Athens Traction Company with energy, and the Elmira, Corning & Waverly offers a small share of its load. On the average the railway load is 160 kw for 24 hours. This is metered at the station switchboard, and is charged for at the rate of $.0175 per

kw-hour on a minimum basis of $50 per year of kilowatt demand. There is gas competition in all of the towns, gas selling for $1.50 per 1000 cu. ft. for illuminating purposes and $1.25 per 1000 cu. ft. when used for fuel.

The Sayre company has gone quite extensively into the question of rates, and has what it termed a compromise flat rate for commercial and residential business and maximum demand, off and on peak, rates for motor circuits, although every installation has a watt-hour meter. The idea has been to get down to as near a flat-rate basis as possible, and with that end in view observations were taken of each service for two years. Against this was checked the station peak on each circuit and the average meter readings for long and short months, from which the average income per kilowatt demand was obtained. This was then divided into a flat and a variable charge, for, in the opinion of the company, a rate combining the furnishing of electric service and energy supply at one price per kw-hour is not as equitable as a rate separating the items and charges. In the latter case the service and energy are sold at a greatly reduced cost to the customer and on a safer and a fairer basis to both the company and its patrons. The lighting rate for temporary service is 15 cents per kw-hour less a 10 per cent discount for prompt payment; the customer paying the connection charges. The compromise flat rate on yearly contract for commercial service is $6.66 per kilowatt demand as rated by maximum-demand instrument readings and 2.25 cents per kw-hour for the energy used.

The compromise flat rate for residential service is $5 per kilowatt demand as rated by schedule and 2.25 cents per kw-hour for the energy used. In both instances the minimum bill is $1.10 per month and a 10 per cent discount is allowed on accounts paid on or before the tenth of the month. The maximum-demand rates for motor service off-peak is $30 per kilowatt of demand and 1 cent per kw-hour for the energy used. The demand is determined by instrument readings and the rate is not subject to cash discount. The on-peak rate is $36 per year per kilowatt demand and 1 cent for the energy used.

In applying the rate for heating devices no installation or demand charge is made, so that all energy used for heating costs only 2.25 cents per kw-hour. Ranges, etc., are carried for eight months without installation charge, which makes the cost for

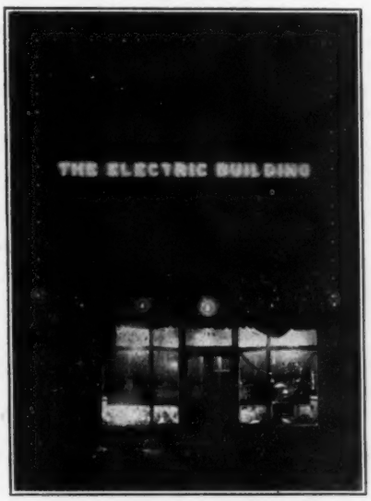


Fig. 7—Office of Company on Main Street.

electricity equivalent to gas at 85 cents per 1000 cu. ft. In this way it is hoped to build up a day heating load. The rates for motor circuits are, as stated, $1.87 per kilowatt or demand per month off peak and $2.25 on peak plus 1 cent per kw-hour for the energy used, and in canvassing for this business the company estimates the peak requirements of a factory, for instance, and makes a proposition to the owner to place in it a motor drive complete. This estimate includes the horse-power demand and the load factor which govern the energy used per month and a trial installation is made for three months, the charge made during that time being that estimated. At the end of three months if the electric light company has kept within its estimate, the customer buys the motors and signs a contract for service; the cost of the motors being divided into 36 monthly payments, if desired.

If the original estimate made by the lighting company proves to have been too small, it has the option after the three-months' trial to increase the charge to that shown to be correct, and if the customer is satisfied, he signs a contract on that basis; if not, the motors are removed without expense to him, the loss falling on the lighting company. In this way the company has

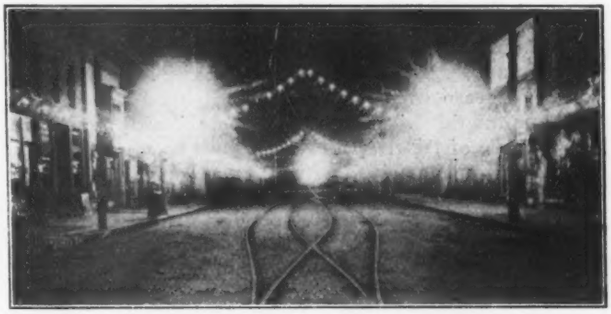


Fig. 8—Street Lighting in Waverly, N. Y.

been enabled to get motor business, and in a number of cases was able to show a saving over previous methods of operation sufficient to pay for the motor equipment in less than three years. The retail rate for motor circuits on which no yearly contract is signed ranges from 9 cents to 5.5 cents per kw-hour less 10 per cent discount for cash payment.

A special lighting scheme has been adopted by the Sayre company in Waverly and Sayre. A view of this special lighting at Waverly, N. Y., during the recent holiday season is shown herewith. The festoons across the roadway, however, are not a part of the general lighting scheme. Running parallel with the curb on both sides of the street and 12 ft. above the sidewalk are two feed wires and a messenger wire. Lamps rated at 8 cp are suspended from these wires and spaced every 4 ft. 4 in. These burn from dusk until 10 p. m., and are paid for by the merchants in front of whose premises the lamps are at a flat rate of $1 per month per store front. A number of electric signs and some windows are lighted from the same circuits at the same rate, which nets about 8 cents per kw-hour. The signs on the power-house chimney are shown in one of the engravings. These are made up of 4-ft. letters reading "Electric Power Cheap," and are flashed on and off. The office building of the company in Sayre is outlined and has a large electric sign across its front. Over the roadway in front of the building is another large electric sign bearing the name of the company. In addition the company has in contemplation the erection of a number of small electric signs or transparencies on the poles at the intersections of the principal streets. These signs or transparencies will be large enough to take a 24-in. x 18-in. reader, and will be used to advertise flatirons, tungsten lamps, etc. The story will be changed every week.

The public lighting comprises 37 6.6-amp arcs at $68 and 54 50-cp incandescents at $30 in Waverly; 10 arcs burning until 1 a. m. at $55 and 14 32-cp incandescent lamps burning until 1 a. m. at $18 in South Waverly; 10 6.6-amp arcs and 178 30-cp incandescent lamps at $20 in Sayre, and 26 arcs, 25 of which burn until 1 a. m., and 31 32-cp incandescent lamps burning until 1 a. m. in Athens. All of the pole lines, circuits, etc., in Waverly are owned by the Waverly Electric Light & Power Company, whose property is leased by the Sayre company, and whose entire capital stock is owned by that company. The officers of the company are: President, Mr. T. M. R. Meikleham; vice-president, Mr. P. T. Glidden; secretary, Mr. B. S. Lachlan; treasurer, Mr. W. B. Dinsmore, and general manager, Mr. F. S. Nicholson.

QUEENSBORO BRIDGE ILLUMINATION.

Lighting of New Cantilever Across the East River and the Island Over Which It Passes.

THE Queensboro Bridge, New York City, bears the distinction of being not only one of the great cantilever bridge structures of the world, but is the only cantilever bridge across the East River, which boasts of three of the largest suspension bridges ever built, the Brooklyn Bridge, the Williamsburg Bridge and the Manhattan Bridge. The structure connects the Borough of Manhattan with the Borough of Queens, passing from East Fifty-ninth Street over Blackwell's Island to Ravenswood, L. I. It possesses one roadway, two footwalks and four railway tracks and from end to end is 7448.7 ft. long. Five cantilever and anchor spans are embodied in its makeup, aggregating 3724 ft. between anchorages and including a span over the west channel of the East River 1182 ft. in length. Its total cost was approximately $22,000,000. In the middle of the river between the two boroughs is Blackwell's Island, owned by the city of New York and used by it for hospital, prison and other purposes connected with the Department of Charities and Correction. Over this island the connecting span passes and on either side are supporting towers. When the question of lighting the bridge was taken up the desirability of lighting Blackwell's Island by electricity naturally presented itself, and the Department of Water Supply, Gas and Electricity, on which the solution of such problems falls, determined on the present plan and awarded the contract for supplying the electrical energy to the New York Edison Company.

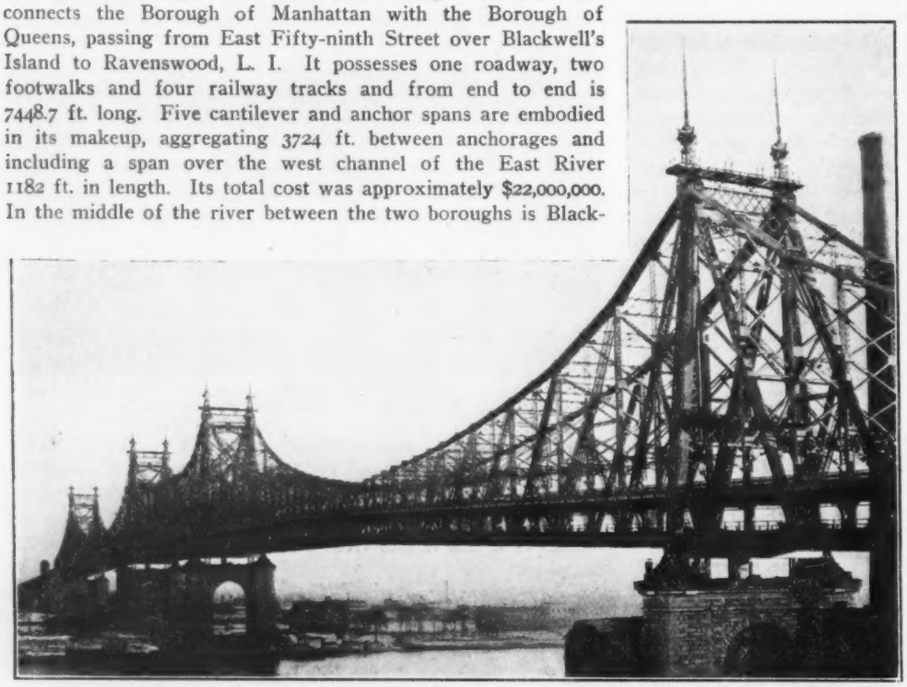


Fig. 1.—Queensboro Bridge Across the East River, New York.

Situated as they are with their load centers practically coincident, it is apparent that the electrical needs of Blackwell's Island and the Queensboro Bridge are most simply and economically served from a distribution center located at their intersection. Full advantage has been taken of this desirable arrangement by locating the transformer substation feeding this combination directly under the bridge, and by employing alternating-current, 2300-volt, two-phase, 60-cycle distribution. Thus arranged, the bridge lighting is treated as a part of the line controlled and operated from the station. This is advantageous in that the whole bridge load is constantly under the eye of a skilled operator and the number of a section in which any trouble occurs is immediately telephoned to the proper authorities. As the bridge is divided into six sections, electrically, a breakdown, to affect any considerable area, would have to occur simultaneously on several separate and distinct sections, a combination of events not likely to occur. To safeguard the service still further, in case of emergency, the secondary system on the bridge can be tied together so as to operate as two units, with three sections to a unit. With this arrangement it is possible to continue the service on all sections even though the high-tension supply of four sections, two in each unit group, should fail through any cause.

The secondary system mentioned above consists of two No. 00 three-wire feeders extending the length of the structure and carried on cleat work under the edge of each footwalk. Conduit is used to carry the taps from these feeders to the various individual incandescent and arc lamps. The conduits terminate over the feeders under the shelter of the footwalk and the wires they contain are spliced directly onto the cables. Each feeder is divided into three equal sections and three transformers are tapped in at the section midpoints. At the two breaks in the feeder, tie switches are installed. The transformers are rated at 30 kw and are mounted among the beams above the roadway. Each is enclosed in a sheet-iron housing, within which are also the high-tension fuses. A No. 6 duplex rubber-covered cable of special design to prevent the absorption of moisture is used to feed each transformer. This cable is run in conduit over the bridge structure. At the expansion points of the bridge, boxes are provided into which and out of which the conduit can slide as the bridge expands and contracts.

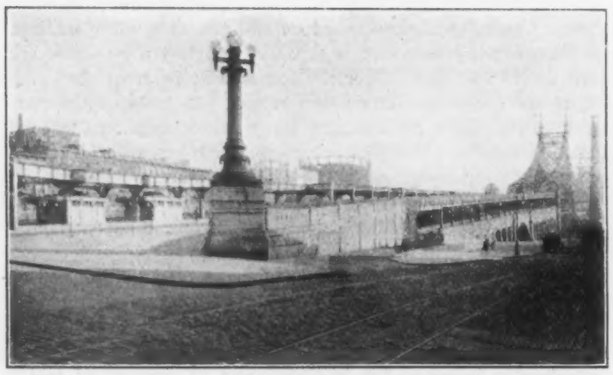


Fig. 2.—Manhattan Approach to Bridge.

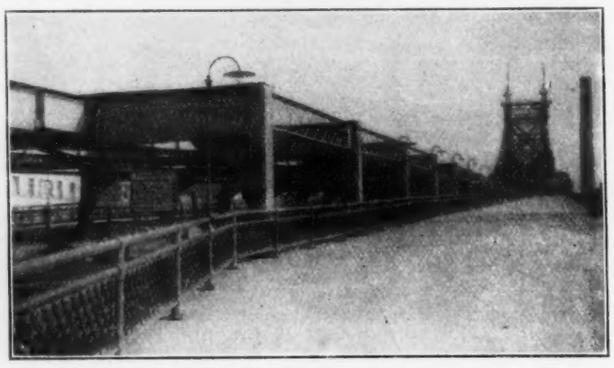


Fig. 3.—Incandescent Lamps on the Promenade.

The lighting of the structure proper is accomplished by the use of 75 arc lamps on the roadway and 430 incandescent lamps on the footwalks. The arc lamps on the roadway are rated at

7.5 amp at 105 volts and are suspended from a fixture bolted to the steel beams. The arc lamp is so located with reference to the bottom of the beams that although the illumination of the roadway and of objects on it is good, the lamps are not in the line of vision until approached quite closely, a very desirable arrangement. The lamps are spaced 100 ft. apart and are placed alternately over the north and south sides of the roadway. Use is made of reflectors which cut off the light at the point where it will begin to illuminate the beams and redirect it down on to the roadway. The brackets supporting the incandescent lamps are mounted on the hand rail on the inside of the footwalks and are equipped with 20-in. radial wave reflectors. The lamps are spaced about 28 ft. apart on each wall and are fed from No. 14 wire taps, each lamp circuit being protected by plug fuses.

The Manhattan trolley subway, the workshops and the arches under the bridge are illuminated from the direct-current system of the New York Edison Company, which has installed for this purpose two 500,000 circ. mil three-wire feeders. These are brought into a room in the trolley subway and the energy after being metered passes in through the buses of the distribution board. The switches controlling the various panel boxes, of which there are six, are mounted on this board. There are two panel boards in the trolley subway, two in the workshops, one under the arch west of First Avenue and one under the arch east of First Avenue. The panel at the west end of the subway is fed through two 300,000 circ. mil three-wire feeders; the other panel at the east end, through two No. 0 three-wire feeders; the panels in the workshops are fed from a No. 000 three-wire feeder; that to the west of First Avenue, through a No. 000 three-wire feeder and the panel to the east of First Avenue receives energy over a 250,000 circ. mil three-wire cable. The illumination of the trolley subway is accomplished by the use of 597 50-watt Gem lamps on wall brackets placed around all of the steel beams supporting the roof of the subway. The lamps are equipped with reflectors, and the conduit to them is run concealed. Controlled from one panel are the two post clusters, one at Fifty-ninth and the other at Sixtieth Street and Second Avenue. Each contains 16 100-watt Gem lamps and is provided with milk globes covering the various small groups that go to make up the post cluster.

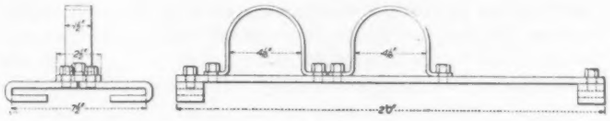


Fig. 6.—Detail of Cable Support.

The arch west of First Avenue is lighted by 60 50-watt Gem lamps equipped with reflectors mounted on five-lamp fixtures suspended from the arches. The conduit for this arch, the First Avenue arch and the arch east of First Avenue is run in the space between the beams holding the roadway in position and the steelwork of the arches, which allows easy access to all conduit from these arches. The First Avenue arch is illuminated by 20 100-watt Gem lamps in sockets placed at the highest point of each dome and covered with a bowl globe having wire cast in the glass. Most interesting of the three arches is the one east of First Avenue. Here clusters of tungsten lamps are used ranging from groups of three 60-watt lamps at the low point of the arch to groups of five 80-watt lamps where the bridge rises farther away from the ground. The ceiling and pillars in this arch are finished in white tiling and the small arches or

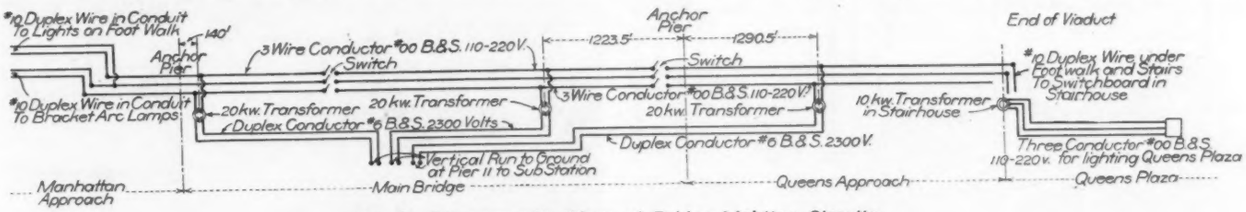

#10 Duplex Wire in Conduit To Lights on Foot Walk
140'
Anchor Pier
3 Wire Conductor #00 B.&S. 110-220V.
Switch
1223.5'
Anchor Pier
1290.5'
Switch
End of Viaduct
#10 Duplex Wire under Foot walk and Stairs To Switchboard in Stairhouse
#10 Duplex Wire in Conduit To Bracket Arc Lamps
20 kw. Transformer
20 kw. Transformer
Duplex Conductor #6 B.&S. 2300 Volts
3 Wire Conductor #00 B.&S. 110-220V.
20 kw. Transformer
10 kw. Transformer in Stairhouse
Duplex Conductor #6 B.&S. 2300V.
Vertical Run to Ground at Pier 11 to Sub Station
Three Conductor #00 B.&S. 110-220v. for lighting Queens Plaza
Manhattan Approach
Main Bridge
Queens Approach
Queens Plaza

Fig. 4.—Diagrammatic Plans of Bridge Lighting Circuits.

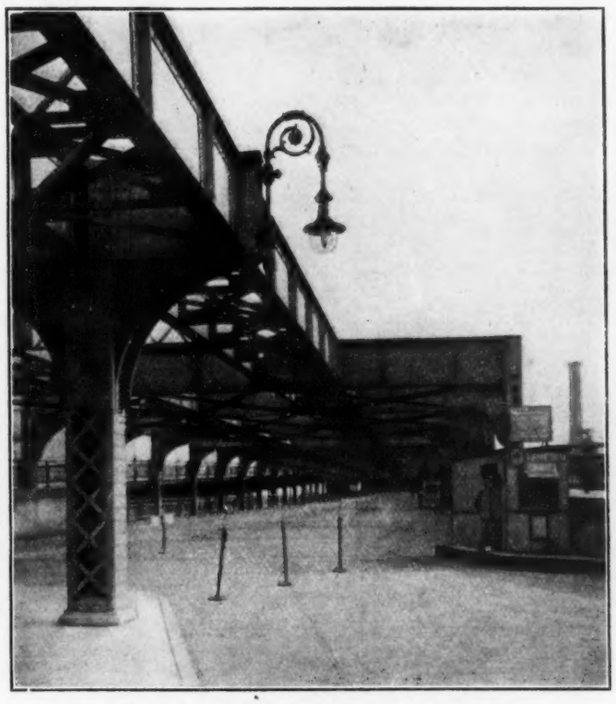


Fig. 5.—Arc Lamp, Manhattan Entrance.

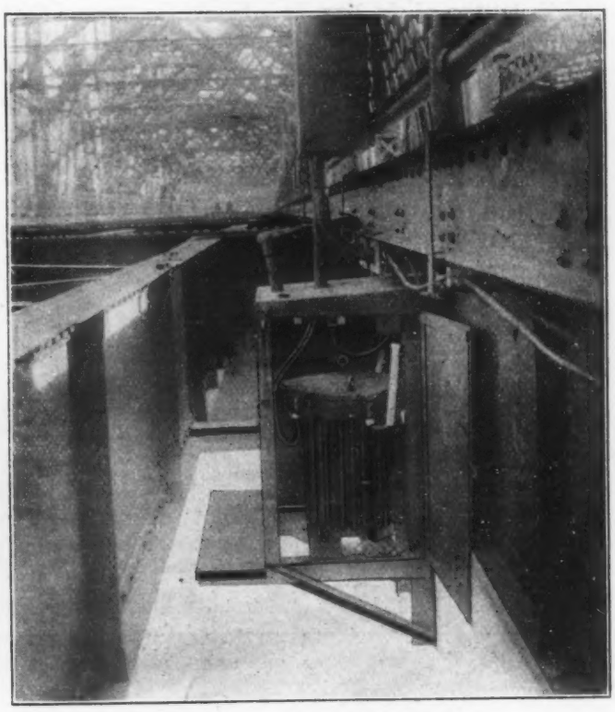


Fig. 7.—Transformer on Bridge Structure.

domes at the centers of which the clusters are located are shaped to the curves of a reflector, throwing the light down in such manner as to produce a very uniform and very good illumination. There are 36 60-watt and 103 80-watt lamps used in this space.

At the end of the last-mentioned arch is the Manhattan anchorage. In this two elevators are installed to operate between the street level and the roadway and footwalks. These are duplicated in the Queens anchorage. The elevators in Manhattan are fed from the Edison direct-current system through a service from a nearby main; the two in Queens are operated by two-phase induction motors receiving energy from the Blackwell's Island substation.

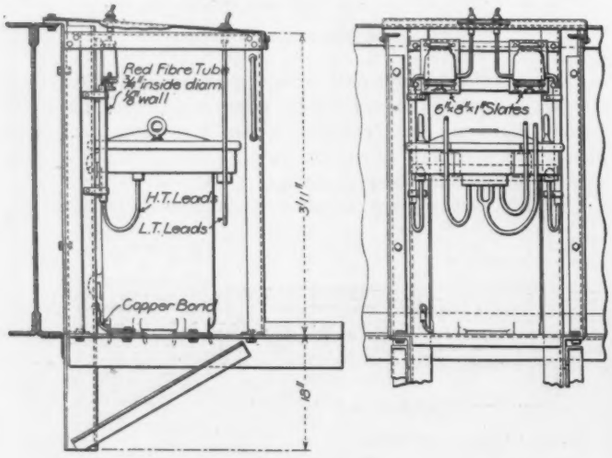


Fig. 8.—Details of Transformer Housing on Bridge.

Over the Queensboro Bridge there is a trolley system operating at 550 volts direct curent and fed from the Sixtieth Street substation of the New York Edison Company. Cables are brought into the switchboard room mentioned in connection with the terminal lighting of the structure. A board is installed in this room and is provided with two 2000-amp meters and a single-pole switch in each of the four feeders, allowing any one to be cut out in case of trouble on it. The feeder system on the structure is divided in two sections—the north and the south—each of which is separate and independent and each of which is supplied by two 1,000,000 circ. mil cables. These are carried on insulators mounted on the steel work on the sides of the footpaths and No. 0000 taps are taken to the trolley wires every 300 ft. Four trolley tracks cross the bridge, two on the roadway and two outside of it. Each track is equipped with an overhead trolley wire and those outside of the roadway have a slot to permit the installation of the conduit system. There are six trolley loops on the Manhattan trolley terminal, the switching for which will be accomplished when the traffic warrants it by solenoids mounted between the tracks and controlled from a platform near the car entrance to the subway. The above constitutes the electrical equipment of the bridge, the lighting and elevator load of which alone aggregates about 200 kw.

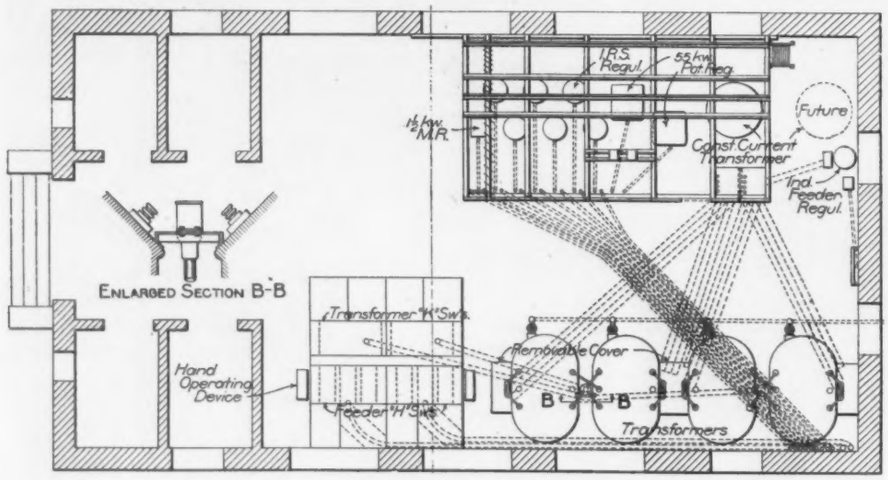


Fig. 9.—Plan of Blackwell's Island Substation.

BLACKWELL'S ISLAND INSTALLATION.

Electricity is distributed on Blackwell's Island at 2300 volts, two-phase, 60-cycles on overhead pole lines. Underground distribution would have been desirable on the island for several reasons, but unfortunately Blackwell's Island is almost all solid rock so that overhead line construction was adopted owing to the enormous expense of underground mains. A double-pole line carries the two-phase circuits and the series lighting lines from the substation on the west road under the bridge to the east road, where the line branches, one two-phase circuit and the series circuit being carried north to the Metropolitan Hospital District and a two-phase circuit south to the City Hospital District. Chestnut poles are used principally for this work. These are 35 ft. long, buried 5 ft. in the earth, creosoted, and carry for most work two six-pin arms. The spacing between poles is 100 ft. A No. 6 bare copper ground wire is carried around the line on pins affixed to the top of the poles, and this is fastened to plates buried in coke at every transformer pole and is also connected to the water piping in a number of places. The wire is run chiefly for the purpose of secondary grounding, as little or no trouble is anticipated from lightning, the bridge located as it is over the main line and extending into the air several hundred feet, being expected to act as a very effective ground wire for the whole island and to ward off any lightning discharge over this area.

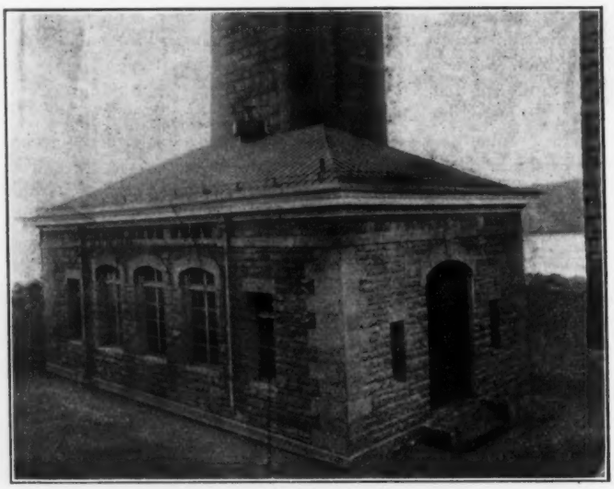


Fig. 10.—Blackwell's Island Substation.

Four No. 1 stranded cables are run as far north as the beginning of the Metropolitan Hospital District, where the line branches into three smaller lines made up of No. 4 and No. 6 wire. The south line has four No. 4 wires as far as the City Hospital, where two smaller circuits of No. 6 wire branch out. As yet there is no secondary system of mains, each installation having its individual transformer, but as the new layout of the

island is completed, and it is growing very rapidly, systems of secondary mains will be installed fed from a few large units. The island when completed will be cut up in three divisions, separated by park ground, and the load in each section will be fairly compact, permitting of the above arrangement.

For installations requiring the use of transformers less than 20 kw in size the transformers are mounted on the poles, but larger transformers are installed in brick or stone vaults. Instances of these vault installations are in the new Nurses'

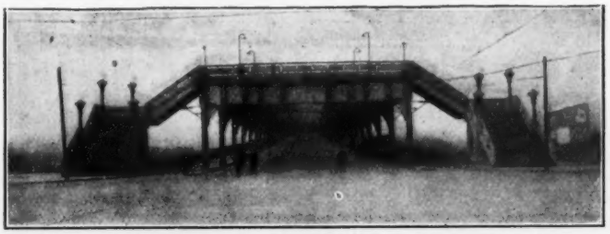


Fig. 11.—Queens Borough Approach to Bridge.

Home, the new Tuberculosis Infirmary and the Metropolitan Hospital. All secondary services are brought into the buildings underground, the conduit being run down the transformer pole. High-tension fuses are in all cases mounted on the poles, even in places where the transformers are placed in vaults and the poles are stepped. By this means a breakdown in the lead cable from the pole to the transformer will only put that individual installation out of service without affecting the rest of the line. In the vaults, hand-operated oil switches of simple construction are used ahead of the transformer, permitting them to be cut out under load if necessary, which is not a safe procedure where only cut-outs are employed. The secondary mains from the transformers on the poles into the buildings are

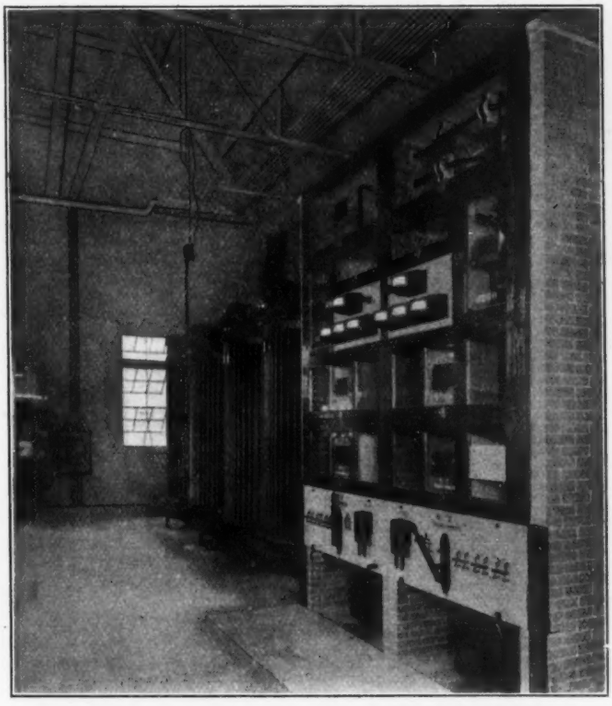


Fig. 12.—Step-Down Transformers in Substation.

made up of lead-covered, rubber-insulated single cable, three for lighting and four for two-phase motor service. Each installation has a lighting and a motor three-pole circuit-breaker with independently operated arms.

The introduction of electricity for lighting and industrial service on Blackwell's Island has made possible many conveniences and the employment of labor-saving devices which would have been impossible without its use. In all of the new buildings electricity is used freely for every purpose to which it can be reasonably applied. Two instances of this are shown in the Nurses' Home in the Metropolitan Hospital District and in the City Hospital kitchen. The latter building, although completed some time before the electrical installation on the island, had to stand idle until energy was turned on, so intimately is electricity connected with its operation. It has installed three electric elevators, two automatic dumbwaiters, numerous coffee mills, meat choppers, ice-cream freezers, potato peelers, dish-washing machines, fans and blowers, besides a very complete lighting installation. The new Nurses' Home, besides having a line of kitchen appliances such as mentioned for the City Hospital kitchen, has four elevators and a vacuum-cleaning outfit driven by a 10-hp motor. The illumination of this building calls for about 1100 50-watt equivalents, and the energy for it is supplied by a 40-kw transformer.

The streets of the island are at present lighted by 72 tungsten and two arc lamps. The number of lamps will be increased several times over when the whole installation has been completed. The tungstens are rated at 60 cp, 75/85 watts, 7.5 amp

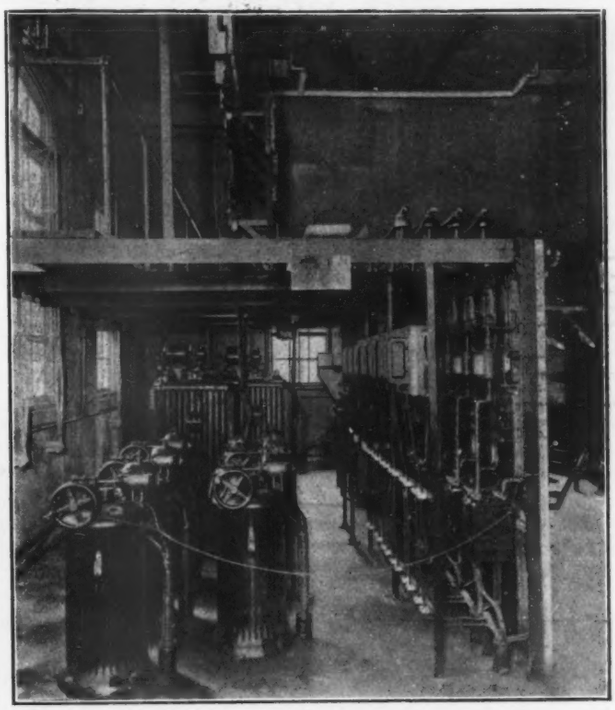


Fig. 13.—Rear of Substation Switchboard.

and standard fixtures with radial-wave reflectors and standard sockets are used throughout. The series lighting scheme embraces only one section of the island, the Metropolitan Hospital District. The line wire for it is No. 6, and it is carried on the lower cross-arm.

All of the electricity used on the Queensboro Bridge and on Blackwell's Island is supplied from the New York Edison Company's station located on the island. An exterior view and interior views and a plan of this substation are given herewith. The exterior of the station conforms in architectural treatment to the other structures on the island. The feeders pass direct from the Waterside Station of the New York Edison Company over the bridge structure to the tower under which the substation is erected and then drop down to the station. Two triplex cables with 250,000 circ. mil conductors are employed to bring the three-phase, 7500-volt current to the substation. Here four 600-kw transformers step down the potential to 2200 volts and are connected in the usual manner to give two-phase current. Automatic potential regulators are connected to all the outgoing feeder circuits and the entire equipment follows standard practice. Details of the clamps used for holding the cables as they drop from the bridge to the substation are shown in Fig. 6.

ELECTRICITY ON AN ILLINOIS FARM.

A Gas Producer Power Plant with Storage-Battery Auxiliary.

As illustrating the increasing use of electricity on farms, the gas-driven electric plant on the farm of Mr. Chauncey W. Broughton, in DeKalb County, Illinois, is of particular interest. This farm consists of 600 acres of the rich soil of Northern Illinois, and is about nine miles southwest of the city of DeKalb, near Carlton, Ill. Its owner is a progressive young man who was born on the place, and who has made something of a study of electrical applications, being himself an inventor

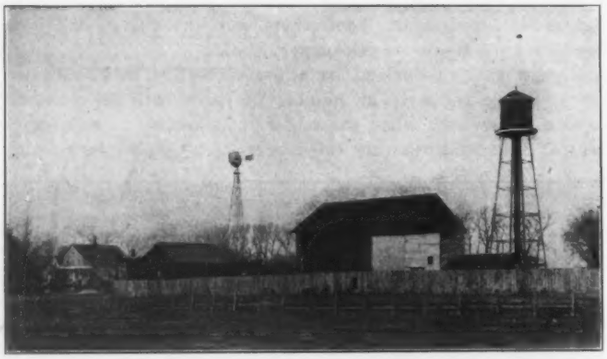


Fig. 1—View of House and Farm Buildings.

of an electromagnetic appliance for securing and releasing mail bags from moving trains. His principal business, however, is farming, which he does successfully, and he finds the use of electricity for lighting and the operation of machinery a distinct advantage as well as great convenience. Fig. 1 is a view of Mr. Broughton's residence and of some of the farm buildings, showing power house, pole line, water tank, etc.

In its essential features the plant consists of a gas-producer installation supplying gas for a 25 hp, two-cylinder gas engine to which are belted a 16-kw, 125-volt direct-current generator and a pump used for elevating water to an elevated tank, from which water is piped about the premises, and which also affords fire protection. The generator supplies electricity to about 150 lamps ranging from 8 cp to 32 cp in ordinary carbon lamps,

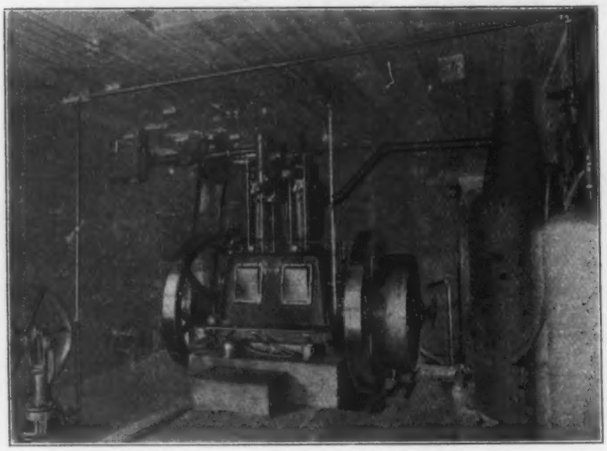


Fig. 2—Gas Engine End of Power House.

and also including some 40-watt and 60-watt tungstens. These lamps are used to light the family residence and also a tenant house at some distance, as well as the various barns, corn cribs and other buildings on the premises. There are also some outdoor lamps.

Three motors are connected to the power-house circuits. Of these the largest, a 17½-hp machine, is mounted on a steel horse-drawn truck especially built for the purpose, and it can be transported anywhere about the premises to operate various classes of machinery through flexible rubber-covered wires attached to outlets provided at various positions in the barns and outbuildings. The second motor, of 5 hp, is mounted on skids and is also portable, although not quite so readily, perhaps, as the truck-mounted motor. It is usually employed for driving a corn elevator, for sawing wood, or other purposes of that character. The larger motor may be used for threshing, shelling corn, cutting ensilage, operating a hay hoist, or the like. The third motor is a small machine of ¼ hp and is mounted on the kitchen wall in the farm residence, where it is used to drive a "1900" washing machine and wringer.

A storage battery of 56 cells, in glass jars, made by the Electric Storage Battery Company, is installed in a separate room in the power house. It is used to supply energy to the lighting circuits at night. It also furnishes electricity for an emergency burglar-alarm circuit connecting the farmhouse with the tenant house. This circuit is controlled by a snap switch placed at the head of the bed in Mr. Broughton's sleeping room. In case it is necessary to summon help in the absence of the master of the house, or for any other reason, a turn of this switch rings a 4-in. gong in the tenant house, and the workmen employed about the place would respond with alacrity.

Another switch placed at the head of the bed connects the lamps on an emergency lighting circuit, and these lamps, flashing in the eyes of a burglar or other intruder, would serve to disconcert him while the outside help summoned by the gong was arriving. The existence of the burglar alarm to the tenant house and the emergency lighting circuit give a greater feeling of security to the women in the house in case it is advisable for Mr. Broughton to be away for the night. A pilot lamp in the tenant house burglar-alarm circuit lights up at the head of the bed when the distant bell is ringing to show that the circuit is in working condition.

Gas from the producer plant is piped 320 ft. to the house, and is burned in the furnace of the steam-heating plant, as well

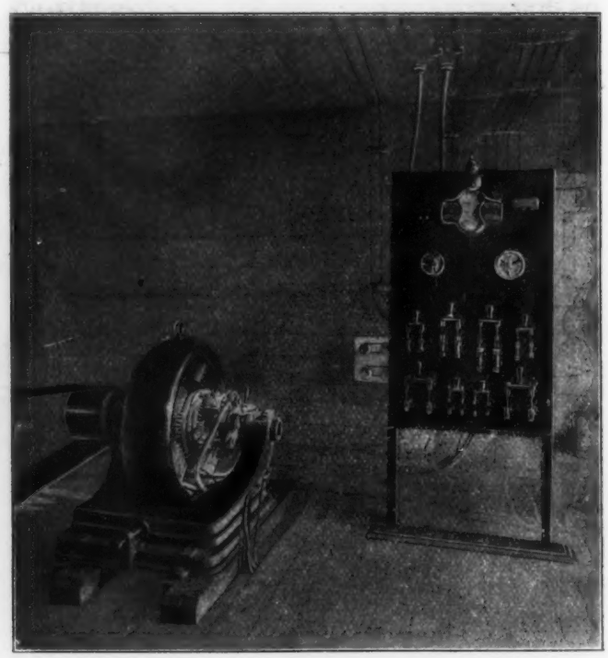


Fig. 3—Generator and Switchboard in Power Plant.

as used for cooking, so that in this way heat as well as power and light is obtained from the power plant, and there is no annoyance from handling coal and ashes in the house. Owing to the use of the gas for fuel as well as to operate the engine, the gas producer is of the pressure type. To make the plant practical, the generating of gas must be effected automatically, and to secure this result a steam-jet system is used.

The power-generating machinery is installed in a separate

building some distance from the residence. This building is partly of concrete and partly of corrugated steel, although boarded on the outside, so that from the road it has the appearance of a frame building. Referring to Fig. 1, this building will be seen on the right of the picture, next to the fence. It will be noted that the structure has a higher central portion and a wing on each side. The wing at the right hand, as viewed in the picture, is devoted to coal storage, and has a capacity for 80

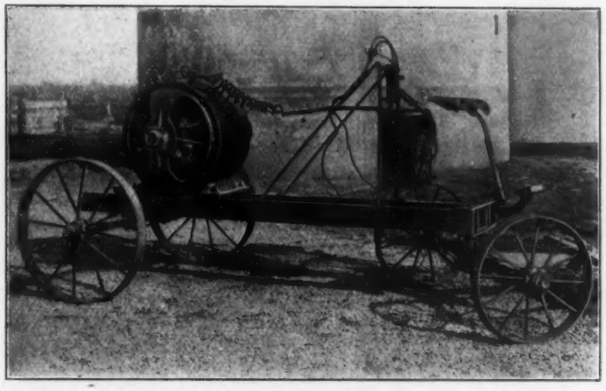


Fig. 4—Motor on Truck for Driving Farm Machinery.

tons of coal. The pea size of anthracite coal is used to charge the producer. The 40-hp producer plant, consisting of the gas generator, economizer and scrubber, occupies a portion of the central part of the building. The remainder of the central part is used for storage, while the left wing is the power plant proper. It is interesting to note that over the producer room there is a loft used for drying seed corn. The ceiling of the producer room is provided with apertures so that the waste heat in the producer plant is utilized in the room above in drying corn.

A small gas-fired boiler placed in the power house furnishes steam at 80 lb. pressure, and this is introduced as a jet in the economizer of the producer, and also furnishes heat for the engine room. A constant water lever and constant fire are required to make the plant automatic. To secure the water level a small iron float box 19 x 10 in., fitted with an 8-in. copper-ball float, is provided. This float is connected by means of an arm and toggle to a chronometer valve that admits steam to a small Burnham pump. With proper adjustment of this device the water level is kept constant, and by regulating the valve that admits gas to the boiler a constant heat is maintained to carry 80 lb. pressure.

Besides the steam boiler, the power plant contains a 25-hp, two cylinder, throttling-governed gas engine, belted to a 16-kw Fort Wayne 125-volt, direct-current generator turning at 1250 r.p.m. The gas engine will fluctuate less than 2 per cent in speed from no-load to full-load, and a silver dollar will remain balanced on edge on the cylinder casing while the engine is running. The engine was made by the International Harvester Company of America, and the entire plant was designed and installed by the Aurora, Ill., general agency of that company. Fig. 2 shows the gas-engine side of the power plant (with belts removed from the gas engine), while Fig. 3 illustrates the generator and switchboard. The switchboard is a slate panel 40 in. wide and 58 in. high, and is equipped with a duplex voltmeter and ammeter, as well as the necessary switches for generator, lines and battery.

To the engine flywheel is belted not only the generator but a pump used to supply water for the general purposes about the premises. This pump lifts the water from a 105-ft. well, in which the water rises to within 60 ft. of the top. A 12,000-gal. tank which forms a conspicuous feature of the premises, as may be seen by Fig. 1, is elevated 60 ft. above the ground on a steel tower. As the tank itself is 12 ft. high, the lift of the gas-engine driven pump is thus 132 ft. Water is distributed from the elevated tank at about 35 lb. pressure. As an auxiliary, a former windmill-driven pump is retained, the water from this pump being supplied first to a large reservoir tank on the ground and then, by gravity, to watering troughs for cattle on a lower level. Should the windmill not supply sufficient water for the cattle, a connection is made by which water from the elevated tank can be turned into the reservoir tank on the surface of the ground with which the windmill pump is connected.

The electric motors used about the place were made by the Fort Wayne Electric Works. The larger one, mounted on its steel truck, is shown in Fig. 4, while Fig. 5 is a picture of the corn-elevating machinery in operation, the electric motor being concealed in a housing behind the wagon. This wagon is gradually tipped by gearing connected to the same motor. Its load of corn is fed into the bottom of the conveyor and so taken into the barn.

Overhead pole lines convey the electricity from the power house to the residence and barns and various farm buildings. One interesting feature is that all of the poles are set in concrete. There are about 1700 ft. of pole line on the premises. Two 32-cp lamps are used for outside lighting. One is controlled from the east barn, so that the farm hands can light the barnyard while they are at work. The other exterior lamp is controlled from the house. In the house electric lighting is supplied plentifully from modern ceiling and bracket fixtures. The living-room has a beamed ceiling, and an incandescent lamp is placed in the center of each ceiling panel. Porch lamps are provided in handsome lantern fixtures. Electric heating is not used at present, but electric flatirons will soon be introduced. A private telephone line connects the family residence with the tenant house.

The gas engine is water-cooled. By discharging the cooling water from an elevation over a series of baffles, the water is cooled and is used over again in a continuous cycle.

While the farm is adapted for diversified agriculture, Mr. Broughton pays a good deal of attention to the raising of cattle, growing large quantities of corn for that purpose. He also contemplates the establishment of a dairy, and is arranging his west barn for dairy purposes. Here the barnyard is paved with concrete and the drinking troughs for the cows are also of concrete, making unusually clean and sanitary construction. One corner of the floor of the barn has been laid with concrete, and this will be the milking floor for the dairy. Here will be installed an electro-pneumatic milking machine, so that four cows may be milked at once. The provision of the milking floor of a dairy barn does away with a long row of stanchions and en-

Fig. 5—Motor-Driven Corn Elevator and Wagon Tipper.

ables the premises to be kept in a cleaner and more healthful condition.

The power plant is operated by a man employed about the place, who is not required to give his entire time to the work and is enabled to do a number of other odd jobs about the premises. The tenant house is supplied with electric lighting and running water—something of an improvement over the average tenant house on an American farm. The plant is in use every day, and Mr. Broughton states that the average coal consump-

tion is about 2 bu. of pea coal daily. Thus while the first cost is somewhat high, the operating expense is small.

One point to be remembered in connection with farm electric light plants is that the lighting of the barns, cribs, sheds and other buildings enables the men employed about the premises to do a great deal more work in the buildings than before the electric lamps were introduced. The average barn is a gloomy, cavernous sort of place, where time may be lost in semi-groping about, but the availability of electricity enables the interior to be flooded with light and renders it just as easy to work in as any city workshop. Electric lighting, with the fittings properly installed, also reduces the fire hazard, which is an item of some importance to the farmer.

TESTS OF TURBINE ALTERNATORS.

Descriptions of the Tests to Which Alternating-Current Generators Are Subjected Before Being Shipped.

By Howard M. Nichols.

THE description of turbine-alternator testing given below covers the practice of one of the large electrical manufacturing companies. The alternators are of the high-speed type and are directly connected to vertical steam turbines, with the exception of the smaller sizes, which are built in horizontal units. The testing floor is divided into a number of so-called bases and each base has connected to it steam and exhaust mains, and armature and field-circuit cables from the testing switchboard.

Current for the field coils of the alternators under test is obtained from a bank of motor-generator sets. The motors are driven from the 500-volt shop mains. The generators are designed for 110 volts; their field currents being obtained from the 500-volt shop mains. The field exciting lines are run through the main testing switchboard. At the switchboard the lines pass through a single-pole knife switch and three controlling rheostats, as shown in Fig. 1. The left-hand box is opened up and a third connection is brought out, as shown in the diagram, from the end of the resistance strip that is normally left open. It is essential in connecting up these rheostats that the diagram be followed exactly as it is very easy to connect them in such a way that without close inspection they appear to be all right and they will work all right until some one happens to manipulate the three hand wheels into one particular combination, which gives a short-circuit on the 500-volt line, and consequently blows the line fuses. The above combination of rheostats makes it possible to obtain very fine steps in adjusting the field current of the alternator under test.

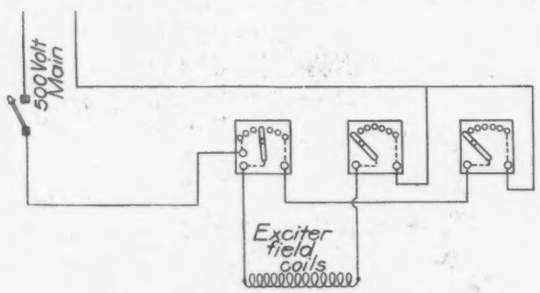


Fig. 1.—Diagram of Field Control Circuit.

Three-phase, star-connected water rheostats are used for load. Three large iron barrels are placed side by side and are bonded together with heavy cable. Each barrel has suspended in it an iron plate. This plate is attached to a heavy flexible cable that leads to one phase on the testing switchboard. The plate is supported by a manila rope that passes through a block overhead and down to a wooden windlass which is placed in convenient reach of an insulated platform. Each barrel has a separate water pipe emptying into the top of it, thus making it possible to vary the amount of cooling water used in each phase. Coarse salt is used to render the water of sufficient conductivity to carry the current of the particular machine under test. An electric call bell connects the barrel house with the testing switchboard and a code of signals is arranged for the lowering or raising of the plate in any particular phase.

The tests are divided into two classes: "commercial tests" and "special tests." All standard machines are given only the commercial test unless they have to meet some special requirements such as are called for in a Government contract, for instance. Special tests consist of two classes, namely, experimental tests to determine the characteristics of machines of new design and acceptance tests on machines that have to meet other than standard conditions. The nature of the last-named tests, of course, is entirely dependent on what guarantees and acceptance are called for in the contract under which the particular machine in test is sold. The present article deals largely with the commercial tests as made upon standard machines.

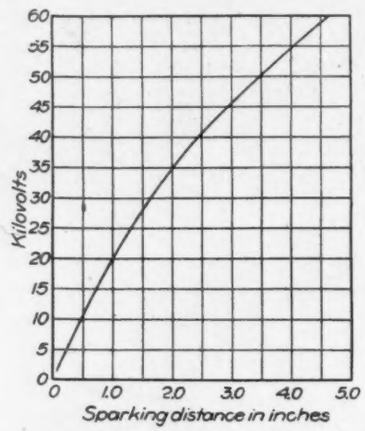


Fig. 2—Sparking Distance Between Needle Points.

Insulation Test of Armature Coils.—All armature coils for high-voltage and special machines should be given high-potential test according to the accompanying table. For testing the coils an artificial ground is created by wrapping each coil closely with tinfoil. The high voltage is then applied between the tinfoil and the winding.

The spark-gap on the testing transformer should be set at 110 per cent of the test voltage and care should be taken to insure that the needle points are sharp and free from rust. Fig. 2 shows the sparking distance between needle points, in inches, for various impressed voltages. Should the gap break down, due to moisture in the air, before the voltmeter registers the proper e.m.f., it should be lengthened not more than 0.01 in. at a time until it will hold, provided, however, that in no case should it be set for a voltage greater than 120 per cent of the test voltage called for in the table. These general instructions apply to all high-potential tests.

Cold Insulation Test of Armature and Field Coils.—The armature and field coils should be given a cold high-potential test according to the table after the coils have been assembled in place and thoroughly baked. However, the test should not be applied until the windings have had time to cool down to the temperature of the surrounding air.

Armature and Field Circuit Resistance (Cold).—The cold resistance of all the phases of the armature, of the separate field coils and the total field circuit should be observed. Use should be made of the drop-of-potential method. For measuring the voltage drop a pair of prick point leads should always be used. These leads terminate in a pair of wooden handles that have sharp contact points which are held firmly on the connections between which it is desired to ascertain the voltage drop. Care should be taken to use instruments that have been recently calibrated and of such a range that the readings will lie around two-thirds of full scale of the instrument. Each measurement should be repeated three times with different

current values and the resistance calculated from these three separate readings should all check within the desired limit of accuracy. All meter numbers, constants, calibration corrections and original readings should be recorded on the test sheet. Moreover, the temperature of the part and of the air should be taken and recorded.

Brush Adjustment.—After the assembling department has finished with a machine, the first thing for the testers to do is to check the "line-up" of the brush holders and carefully trim the brushes with sandpaper to fit the collector rings. All leads, terminals, insulating bushings, etc., should be carefully inspected to see that they are in perfect condition.

Turbine Balance.—The turbine will then be balanced, running free and without field excitation. The balance is obtained by running the turbine at normal speed and observing the vibration. Small balance weights are screwed into the rotor to correct for the vibration, and when a sufficiently perfect balance is obtained these weights are riveted over to keep them in place. During this test the only duty of the electrical testers is to "brake the machine down." This consists of stopping the turbine quickly by loading it up on a set of water rheostats. Without this braking down a machine would run for from a half to three hours, depending on the size, even with all the steam shut off. When no water rheostats are available for "braking down" a machine, it can be slowed down quite rapidly by short-circuiting the armature and giving it sufficient field current to produce about 150 per cent of normal full-load armature current.

Armature Baking.—After the turbine has been balanced the armature windings are to be baked out by passing 150 per cent of full-load armature current through them for half an hour, with the armature short-circuited. The current should be checked in all the phases and the speed should be maintained at the rated value. Readings of field volts and amperes, armature amperes, and the temperature of two opposite armature coils should be taken and recorded at the beginning and end of the run. The field current necessary to give rated armature volts on open circuit at rated speed should be observed and if it does not agree with the current taken by similar machines of the same rating an investigation should be made to find out the reason for the discrepancy.

The field and armature windings should be checked up with the wiring diagram for the machine and the polarity of the field poles should be checked with a pocket compass.

Phase Rotation.—Phase rotation should now be checked with a standard rotation meter. This test should be very carefully performed, as it is highly essential that all machines should have the same phase relations with respect to each other. The phase rotation meter is in reality a small induction motor. It has a coil of wire on an iron core, surrounding an aluminum disk, which is free to rotate. Taps are brought out from the coil corresponding to the various phase relations, and these taps lead to binding posts that are numbered 1, 2, 3 and 4, corresponding to terminals 1, 2, 3 and 4 on the alternator terminal board. The indicator should be connected in circuit and the turbine run at the rated speed, with the armature and field circuits open. If residual magnetism in the alternator field does not cause the disk to rotate, a very weak field current may be used and the direction in which the disk rotates noted. If the armature leads have been brought out to the terminal board in the right order the disk will revolve in the direction of the arrow painted on it. The e.m.f. applied to the indicator should never exceed 300 volts and it should not be kept on longer than one minute.

Field Circuit Baking and High Speed.—With the turbine standing still the revolving field coils should be heated to a temperature of 90 deg. C. by overexciting the field with about double normal field current. A run should then be made for one hour at 120 per cent of rated speed and 120 per cent of normal full-load field magnetism, the armature being open-circuited. The value of the full-load field magnetism can be ascertained from the saturation and impedance curves of similar machines, whose field current at open circuit e.m.f. is the same as the machine under test, or if sufficient water rheostats to carry full load are available, the turbine can be put under full load and the field current necessary to give the rated voltage can be measured directly.

At the completion of the one-hour run the field winding should be open-circuited, without shutting down, and the turbine run until the field coils are cooler than 50 deg. C. A run for half an hour should be made before measuring the temperature of the field coil; if it is hotter than 50 deg. C. an additional run should be made for a half hour longer. The temperature of two field coils should be recorded every half hour, except during the high-speed and cooling runs. The field circuit amperes and volts should be recorded every half hour while the current is on.

After the completion of this test it should be repeated, as defects sometimes appear in the second test that were not apparent during the first run.

Any tendency for an uneven magnetic pull will show up during this test, causing the turbine to vibrate. Poor balance will also cause excessive vibration during the high-speed test.

Open-Circuit Saturation.—The turbine tachometer should be carefully checked with a speed counter and stop-watch, at rated speed. With the turbine running at rated speed, readings are to be taken of armature volts, field-circuit volts and amperes, the speed being carefully checked on the tachometer

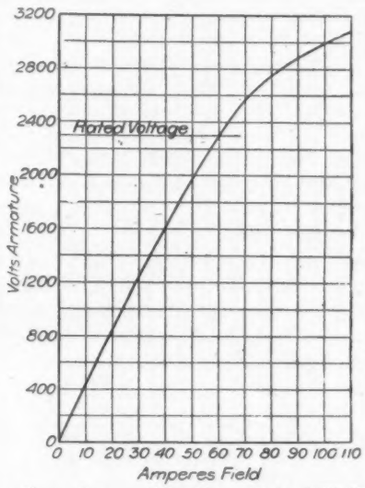


Fig. 3—Saturation Curve (Working Up) 1500-Kw, 2300-Volt Generator

at each reading. One should start with a weak field and increase the field current by steps until the armature voltage is from 130 per cent to 135 per cent of normal. The above readings should be taken at each step and then by steps the field current should be decreased to zero value, readings being taken at each step. About 10 readings should be taken each way. When increasing the field current (working up) it must not be allowed to go above the proper value for that particular step at which a reading is to be taken. In case it should go above the proper value it should be reduced to zero and then brought up to the desired value. When decreasing the field (working down) it should not be allowed to go below its proper value for the step in question. In case it does go below the proper value it should be raised up to the maximum point and then decreased to the desired value. At rated e.m.f. the voltage on all phases should be checked, at least three readings being taken on each. All of the other readings may be taken on a single phase. As each point is taken the field amperes should be plotted against the armature volts to see that the readings lie in a smooth curve. Any point that lies off the curve should be checked.

Good judgment should be exercised in selecting potential transformers for this test, so that the calibrations will cover all the readings and no transformer will be subjected to greater than 110 per cent of its rated voltage. Fig. 3 is a saturation curve of a 1500-kw, 2300-volt generator.

Synchronous Impedance.—All the phase leads of the armature should be short-circuited and the turbine run at rated speed, which must be held constant throughout the test. One should commence with a weak field excitation; enough to give about one-sixth rated armature current, and read armature amperes, field circuit amperes and volts. Then by steps he should increase the field current until the current in the armature is about 175 per cent of its rated full-load value. These readings should be taken at about 10 points. At rated full-load armature current the current should be read in all the phases, three readings being taken in each. Before shutting down the test the armature amperes should be plotted against the field amperes. The points should lie on a straight line. Fig. 4 shows the readings for an impedance test of a 1500-kw, 2300-volt generator.

Heat Run; Eight-Hour Full Load.—This full-load heat run is seldom made except on small machines, because of the energy required. In order to insure having unity power factor water rheostats are used for the load circuit.

Before starting this run measurement should be made of the armature resistance (all phases), total field circuit resistance and temperature measurements. One should bring the turbine up to rated speed, put on normal field excitation and connect a 5-amp ammeter between the upper end of the shaft and upper bearing bracket, noting the deflection, if any. This deflection gives an indication of the extent of magnetic leakage. Full load will then be thrown on and the turbine run at rated speed and rated voltage for eight hours, the load being held constant during the run. The following temperature measurements are to be taken at the beginning and end of the run: (a) Armature core surface (two places); (b) armature ventilating ducts (two places); (c) field spider; (d) collector rings (top and bottom); (e) pole tips (leading and trailing); (f) armature coils, top (two places); (g) armature coils, bottom (two places); (h) revolving field coils, top (two places); (i) revolving field coils, bottom (two places); (j) upper bearing; (k) middle bearing; (l) frame; (m) room (four places). The temperatures a, b, f, g, j, k, l and m are to be taken every half hour, together with the armature amperes, armature volts, field amperes and volts. The load should be held constant in all of the phase windings, and to make sure of this an ammeter should be kept in each phase throughout the run.

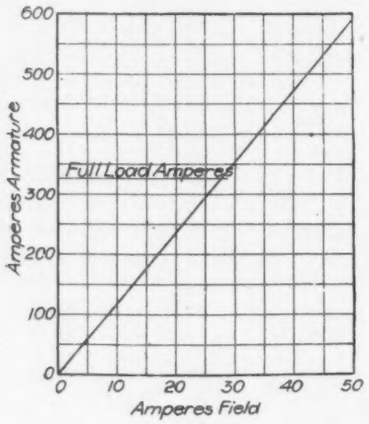


Fig. 4—Impedance Curve 1500-Kw, 2300-Volt Generator.

Compromise Heat Run.—Generators on which the eight-hour full-load heat run is not made will be given a compromise run of four hours open circuit at 110 per cent of rated armature voltage and two hours short-circuit at 150 per cent rated full-load armature current.

Resistance and temperature measurements should be made just as at the start of the full-load heat run and a check should be made for current between the top of shaft and bearing bracket. A run should be made for four hours at rated speed with the armature voltage held at 110 per cent of rated full-load value and with the armature open-circuited. One should take readings of the armature volts, field circuit amperes and volts every hour and take the temperatures a, b, j, k, l and m every half hour. When the run is finished and before shutting down recheck for current between the top of shaft and the upper bearing bracket. Then shut down and measure the temperatures a, b, c, d, e, h, i, j, k, l and m as quickly as possible. There should be enough thermometers at hand so that there will be no delay and when in place the bulbs should be protected from air currents with cotton waste. The temperatures should be read when they reach a constant maximum value.

Immediately following the above run, a run should be taken for two hours with the armature short-circuited and with 150 per cent of full-load armature current flowing. The turbine should be run at rated speed and sufficient field excitation should be applied to give 150 per cent of armature current under short-circuit. The speed and armature current should be held constant throughout the run. One should take readings of armature amperes, field circuit amperes and volts every hour. The temperatures a, b, f, g, j, k, l and m should be observed every half hour. Before shutting down at the end of the run everything should be in readiness to measure resistances and temperatures as expeditiously as possible. After shutting down one should measure the hot resistance of the armature, total field circuit, separate field coils, and the following temperatures: a, b, f, g, h, i, j, k, l and m.

During the heat runs the armature core should be carefully examined for looseness in the laminations by listening for vibrations in the punchings, when the machine is running with the field fully excited and by trying to push a knife blade between the laminations.

The brushes should be watched for sparking during the run, and the condition of the surface of the collector rings noted on shutting down. The brush pressure should be measured with a spring balance and recorded on the test sheet.

Hot High-Potential Test.—Immediately following the heat run the armature and field circuits should be given a hot high-potential test according to the table. A record should be made of the exciting current taken by the testing transformer.

Regulation.—Every machine which is run under load should have a regulation test made on it. One should hold the speed and field current at the value necessary to maintain the rated voltage at full load and read the armature voltage at full, three-quarter, half, one-quarter and no load.

Check Frequency Indicator.—The frequency indicator should be checked by connecting it to the secondary of a potential transformer which will give the rated secondary volts with the rated armature volts impressed on the primary. One should check the turbine speed with a speed counter and stop-watch. At rated speed the indicator needle should stand at zero.

Field Circuit High-Potential Test.—After the revolving-field structure has been removed from the turbine and before the machine has been completely disassembled, one should clean off all dirt and carbon dust from the field coils and collector rings and subject it to high potential according to the table, using the voltage value for assembling machines before the heat run.

Water Rates.—Machines on which a water-rate guarantee is made will be given a water-rate run at the loads and length of time as called for in the contract. Water rheostats will be used for load and the utmost care must be taken to keep the load constant and uniform on all phases throughout the entire run. The speed should be held constant and the tachometer should be checked at the beginning and the end of each run, with a stop-watch and speed counter. One should take readings every 10 minutes of armature volts, amperes and watts, field circuit amperes and volts. The vacuum, supertemperature and steam pressure on the turbine should be held as nearly constant as possible and readings should be taken every 10 minutes. One should carefully weigh and record all the condensed steam. Great care should be taken to see that the

condenser is tight and free from leaks, because any condensing water leaking into the hot well will indicate an erroneous water rate. When salt water is used for condensing purposes, the water should be tested in the hot well with silver nitrate for the presence of chlorine contained in the salt. One should take a sample of water and acidify with nitric acid, adding a few drops of silver nitrate. Any white precipitate indicates the presence of chlorine and shows that the condensing water is leaking through into the hot well.

VOLTAGES FOR HIGH POTENTIAL TESTS.

Rated Terminal Volts.	Volts alternating-current to be applied to armature coils for 1 min. Before Assembling.	After Assembling.	After Heat Run.
800 to 1,200	5,500	4,500	3,500
1,200 " 2,500	8,000	6,500	5,000
2,500 " 3,000	9,000	7,500	6,000
3,000 " 3,500	10,500	9,000	7,000
3,500 " 4,000	12,000	10,000	8,000
4,000 " 4,500	13,500	12,000	9,000
4,500 " 5,000	15,000	13,000	10,000
5,000 " 6,000	18,000	15,000	12,000
6,000 " 7,000	21,000	18,000	14,000
7,000 " 8,000	24,000	20,000	16,000
8,000 " 9,000	27,000	23,000	18,000
9,000 " 10,000	30,000	25,000	20,000
10,000 " 11,000	33,000	28,000	21,000
11,000 " 12,000	36,000	29,000	22,000
12,000 " 13,000	39,000	31,000	23,000
13,000 " 14,000	42,000	33,000	24,000
14,000 " 15,000	43,000	34,000	25,000
15,000 " 16,000	44,000	35,000	26,000
16,000 " 17,000	45,000	36,000	27,000
17,000 " 18,000	46,000	37,000	28,000
18,000 " 19,000	47,000	38,000	29,000
19,000 " 20,000	48,000	39,000	30,000
20,000 " 21,000	49,000	40,000	32,000
21,000 " 22,000	50,000	42,000	33,000
22,000 " 23,000	51,000	43,000	35,000
Volts alternating-current to be applied to field coils for 1 minute.			
Kw.			
0 to 500	.....	2,000	1,500
500 " 1,500	.....	3,000	2,000

GENERAL INSTRUCTIONS.

Only instruments that have been recently calibrated and those having a negligible zero error should be used. During water rate and power tests, one should be careful to keep all instruments away from stray fields. Each pair of instrument leads should be twisted together and the instruments should be placed as far apart as the room on the test table will permit. Use should be made of such instruments and transformers that all readings will lie within the range of calibration. When taking resistance measurements one should always remove the voltmeter from the circuit before turning off the current, as otherwise the "inductive kick," due to the field magnetism, would bend the voltmeter needle.

One should never open a field circuit when it is carrying over 10 amp, except in an emergency, and in any case he should always be sure to short-circuit the ammeter in the field line before opening the circuit, as the inductive discharge of a field carrying full-load current is very heavy.

All readings should be entered directly on the original test sheet as soon as taken.

Danger signs should be conspicuously displayed around all high-tension wires and only authorized testers should be allowed on the testing boards.

Field coils that are damp, due to improper baking of the insulating varnish or other cause, can be dried out by passing sufficient current through them to keep them at a temperature of 95 deg. C. for seven or eight hours. Thermometers should be placed on two field coils and in no instance should the temperature be allowed to go above 100 deg. C.

To calculate full-load field amperes from the saturation and impedance curves, one should read from the saturation curve the field amperes at rated volts and from the impedance curve the field amperes at full-load current. Let i_1 and i_2 represent these two values respectively and I the full-load field amperes. Then

$$I = \sqrt{i_1^2 + i_{11}^2}$$

For the 1500-kw generator, of which curves are given:

$$i_1 = 60$$

$$i_{11} = 27.5$$

$$I = \sqrt{(60)^2 + (27.5)^2} = 66 \text{ amp.}$$

To calculate the electrical regulation of a machine one should read from the saturation curve the voltage obtained when full-load field current is applied. For the curve given this voltage is seen to be 2470; since the rated voltage is 2300, the regulation is as follows:

$$\text{Regulation} = \frac{2470 - 2300}{2300} = 0.074,$$

or 7.4 per cent.

To determine the regulation of the unit as a whole, one should add to this value the per cent speed regulation of the turbine from full load to no load.

In making all high-potential tests all parts not under test must be grounded. If this is not done, the capacity action will create electrostatic strains between the parts, which may be in excess of the insulation strength of the parts in question. In applying this test the voltage should be gradually raised to the desired value, held at this point for one minute and then gradually decreased to a minimum value before opening the testing circuit. It is better to use resistance rather than reactance for regulating the primary circuit of the testing transformer, as the use of reactance changes the transformer ratio.

THE ECONOMICS OF A HYDROELECTRIC DEVELOPMENT.

In view of the widely accepted opinion that hydroelectric energy is usually cheaper than energy developed in a first-class steam plant, it is instructive to consider a recent investigation by Mr. F. W. Dean, a mill architect and engineer, of Boston, in connection with a mill problem where 1400 hp was required 24 hours per day and 310 days per year. The mill was located on a stream where water-power was offered to the company at $10 per gross horse-power per year. The cost of coal was $2.95 per ton, and the issue was whether the mill company should develop the water-power for a transmission of insignificant length to the mill site, supplementing this by auxiliary steam-plant capacity, or whether the total amount of power required should be developed by steam in the mill plant itself. The machinery in the mill was electrically driven, so that the question of distribution did not enter to any material extent.

The flowage records of the stream showed that the available power, at 80 per cent efficiency at the water-wheels, varied from 245 hp to 1400 hp, according to the season. The head varied from 8.4 ft. to 10 ft. During four months of the year the water supply would be sufficient to provide the total power needed. In order to utilize the river for the electrical service of the mill it would be necessary to install an auxiliary steam plant capable of furnishing 646 hp during eight months of the year, and supplying a minimum demand of possibly 100 hp and a maximum demand of over 1150 hp. Therefore, at times when the river was extremely low, practically 80 per cent of the entire 1400 hp would have to come from the steam plant.

The analysis of the situation was made on the basis of the assumption that if the water-power were developed, the cost of its operation would have to be added to the cost of operation of that portion of the steam plant necessary to maintain a steady output of 1400 hp. With no water-power it was necessary to consider only the cost of operation of the steam installation. The estimated cost of the steam plant was based upon compound-condensing installation of modern type. The attendance cost of the engine and the operating cost for the proper portion of the company's boiler plant, both for eight months, were included in the cost of power under the assumption that the water privilege was developed. The estimated cost of the 1400-hp steam-electric engine house was:

Compounding condensing engine,	at	$16.50	per hp	$23,100
Condensing equipment,	at	2.50	" "	3,500
Foundation,	at	4.50	" "	6,300
Engine house,	at	10.00	" "	14,000
Electric generator,	at	12.00	" "	16,800
Switchboard and station wiring,	at	2.00	" "	2,800
Piping in engine room,	at	2.00	" "	2,800
Incidentals, 5 per cent				3,400
Total				$72,700

For the 1400-hp engine one 700-hp boiler was assumed, with one spare 300-hp boiler, making 1000 hp total. The cost of the

boiler plant for the 1400-hp station was, therefore, taken as 10/24 of the cost of the existing 2400-hp installation, which was composed of the following items:

Building, coal crusher, conveyor	$40,400
Stokers for eight 300-hp boilers	10,860
Economizers, 640 tubes, erected complete	9,600
Two fans	3,000
Iron chimney	300
Flue, at $1.00 per hp	2,400
Heater, at 1.50 " "	3,300
Two feed pumps, at 0.50 " "	2,400
Steam piping, at 4.00 " "	9,600
Incidentals, 5 per cent	4,040
Total cost of 2400-hp boiler plant	$85,600

The cost of the boiler plant for the 1400-hp installation in this mill, taken as 10/24 of $85,600, is, therefore, $35,800. The total cost of the 1400-hp steam-power addition to the mill equipment thus would be $108,500.

The estimated cost of developing the water privilege is given below. The water supply at the site is available for power purposes and canal operation, but the latter is the first necessity under the local conditions. After sufficient water has been provided for the canal, one-half of the remaining water is available for use on each side of the river.

The cost of the 1400-hp water-power plant was figured as follows:

Four 300-hp wheels with gates, etc	$9,370
Cost of installing above	800
Gears, yokes, beams, jack shafts	4,000
Cost of installing above	450
Gate frames, rack, etc	4,300
Cost of installing	300
Four governors	3,920
Cost of installing	150
Freight	400
Building	3,190
Earth excavation	5,210
Concrete	21,500
Four generators	1,250
Switchboard and station wiring	7,630
Incidentals, 5 per cent	3,130
Total cost	$65,600

The annual fixed charges were determined by assuming interest to be 5 per cent, repairs 2 per cent, insurance 0.5 per cent and taxes 0.5 per cent, on each plant, and depreciation 2 per cent on the hydroelectric plant and 4 per cent on the steam plant. The total annual charges on the steam plant were 12 per cent of $108,500, or $13,000. For the hydroelectric plant alone the fixed charges were 10 per cent of $65,600, or $6,600, and for the steam-plant auxiliary, with the hydroelectric plant, the total combined fixed charges per year were $19,600.

The estimated cost of operation for the hydroelectric plant with steam auxiliary was found to be $23,512, consisting of $4,880 for attendance, $9,710 for water, $8,455 for coal, and $467 for oil and miscellaneous items. The total yearly expense of doing the work by the water-power and steam auxiliary, including all charges, was, therefore, $43,112. The cost of operating the steam plant alone was figured at $26,008, composed of attendance, $3,780; coal, $21,948, and oil and miscellaneous, $280. The total yearly cost of single steam-plant operation, including the fixed charges, was $39,008.

Thus there was found to be a margin of $4,104 per year in favor of making the addition to the mill power equipment by extending the steam plant rather than undertaking the hydroelectric development. The cost of coal was so low that at the prevailing price charged for water-power it would not pay to assume the cost of the hydroelectric installation. If the water-power privilege could have been secured at a cost of about $5 per horse-power of development, the costs would have been about even, and with free water-power it would have paid to develop the hydroelectric outfit. The cost of transmission from the river to the mill yard would have still further increased the annual expense of the hydroelectric service, although by only a comparatively small amount.

This case shows that it is always important to figure fixed charges with care, and that sometimes where the running costs of a water-power installation are lower than those of a steam plant, it is still more profitable in the long run to forego the hydroelectric development in favor of a steam addition to the equipment. This is an aspect of the water-power situation which the public little appreciates, for there is a widespread opinion abroad in this country that water-power costs little or nothing to maintain, once the development is completed. Cases of this character are useful in indicating that if additional burdens are laid upon hydroelectric developments by the national Government the result can be only utterly to stifle enterprise in a field where the most careful engineering analysis is required to insure a reasonable return upon the investment.

THE PREVENTION AND REMOVAL OF BOILER SCALE—IX.

By W. H. Wakeman.

A successful method of securing soft water is to subject it to the action of lime and soda. If a large tank be filled with water and to this should be added a given weight of softening agent thrown indiscriminately into the tank, it is evident that while some of the water would be supersaturated, a portion might receive the right quantity for good effect, and some not get any. In many cases such water would be worse than the untreated water.

The water softener illustrated in Fig. 1 is of the continuous type; that is, all water passing into it is treated alike, so that

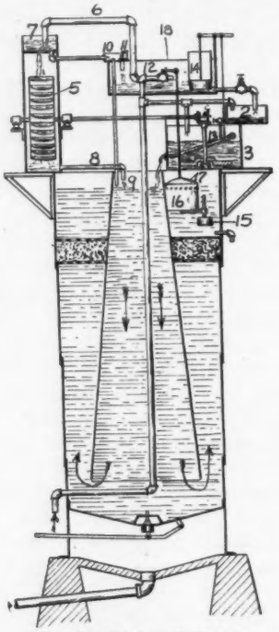


Fig. 1.—Water Softener.

none of it is stronger than the rest. The machine operates as follows: The quantity of lime required to effect the desired result is put into the small tank 2 and enough water added to slake the lime and provide a mixture that will flow freely after the slaking is complete. The mixture is then allowed to flow into the larger tank 3. A quantity of soda is then put into tank 3 and enough water added through the pipe shown to raise the water level to a given point. The vertical agitator shaft 4 is driven through bevel gears by the water wheel 5 and thus keeps the contents of the large tank 3 well mixed. Untreated water enters at the lower left-hand side, as indicated by the arrow, and is delivered through pipe 6 into the small tank or box 7, a greater part of it falling on the water-wheel 5. The solution passes out through pipe 8 and is discharged into the receiver 9, where it mixes with that coming from the large tank 3. A smaller portion of the water from tank 7 flows into the box 10, where it is again divided, part going into tank 12, while the remainder falls through the vertical outlet into the receiver 9. The object of this arrangement is to provide a definite quantity of water for tank 12 as long as the machine is working to its full capacity, therefore, the regulator 11 can be set to allow the required quantity to pass and the remainder overflows into the receiver 9.

The upper part of the device, shown at 13, is a metal pipe, but it is connected to the nozzle which discharges into receiver 9 by a flexible connection which leaves it free to rise and fall as required. Connection is formed between 13 and 14 by two rods and a lever, therefore when the water lever in tank 12 rises, 14 is lifted and 13 is lowered, consequently the quantity discharged into 12 regulates the amount that passes from tank 3 into receiver 9, hence the latter is always saturated in a fixed degree with the required solution.

This water flows downward, as indicated by arrows, at the same rate that it is drawn out through a suitable discharge pipe near the top, but inasmuch as this pipe is much smaller than the receiver 9, its speed in the latter is very slow, and owing to the cone shape of 9 the water moves slower as it falls and this allows impurities to settle to the bottom, whence they are emptied into the sewer at stated intervals through the valve shown.

The partly cleansed water now slowly rises (the speed decreasing on the way up) through the annular space outside of 9 and is filtered through wood fiber, the water emerging from the filter perfectly soft and pure.

The above process continues as long as water is drawn out at the rated capacity of the apparatus, but it is evidently necessary to provide means for shutting it off and starting it automatically when less than full capacity is wanted. This is accomplished as follows: When water is no longer drawn out, and the supply is continued, the level rises in the main tank until the small float 15 rises and closes a valve in the float pot 16. If the supply is continued longer the water rises and enters the holes near the top, and as 16 is filled a float 17 inside of it rises and by means of the connecting rod shown it closes the quick-acting valve 18, thus shutting off the supply to 6 and the whole process is suspended.

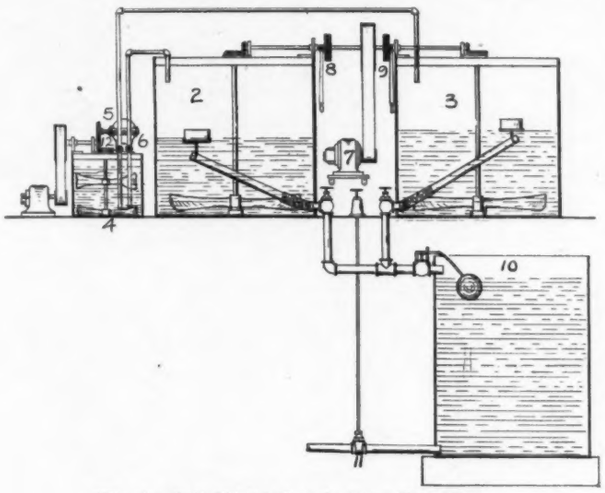


Fig. 2.—Soft Water Supply from Two Tanks.

When water is again drawn out of the large tank, the level falls until 16 is uncovered and 15 falls, opening a valve in the bottom of 16 and allowing all water to run out of it. This lowers float 17, opens valve 18, water is discharged into tank 7 and the entire process is renewed.

When the supply of lime and soda is exhausted, another charge must be put in at once in order to maintain constant operation. The parts are designed so that when tank 12 is full of water it is time to renew the charges in tanks 2 and 3. Notice is given to the engineer by the rising of float 14 to its highest point, where it completes an electric circuit, causing a bell to ring until a switch is turned, shutting off the electricity. The supply is temporarily shut off from pipe 6 and tank 12 is emptied, allowing float 14 to fall. The switch is then closed and the circuit is again ready for use. The tanks 2 and 3 are recharged and the supply to pipe 6 again turned on. As tank 12 slowly fills float 14 rises, float 13 is lowered and the whole process is resumed. While this apparatus seems to be complicated, all of the devices represented are simple and practical, hence are not liable to get out of order.

Fig. 2 illustrates apparatus for supplying soft water intermittently from two tanks. Lime and soda are put into the mixing tank 4 and dissolved in water. This tank is fitted with an agitator driven by a small motor, which also drives the pump. When the mixture is ready for use a valve in the suction pipe 6 is opened, the pump started and water permitted to flow into tank 2. When the solution is pumped out of the mixing tank, the pump is stopped and the motor 7 is started. The clutch 8 is thrown in, causing the paddle in tank 2 to revolve and agitate the solution. During this time the clutch 9 is out, leaving the agitator in tank 3 at rest.

The clutch 8 is then disengaged and the water in tank 2 allowed to stand quiescent until it is ready for use. It is then drawn out through a pipe with a flexible connection, the intake of which is supported by a float. This causes water to be drawn always from a point near the surface, regardless of the quantity in the tank. The water passes into tank 10, from which it is drawn for use through valve 11.

The mixing tank is again charged and when ready for use the suction valve 12 is opened and the mixture discharged into tank 3, which is filled and treated similarly to the method adopted for tank 2. This is repeated alternately, thus keeping a full supply in tank 10 at all times. While the water is treated in two tanks (to which more may be added to increase the supply) thus forming what is called an intermittent system, it is really continuous so far as results are concerned, hence the title continuous water softener is a misnomer to that extent. The process is very simple and does not call for delicate apparatus that is liable to cause trouble and which may fail when badly needed for use.

In thousands of plants well water is easily obtained in large quantities at small expense. In most instances the water is apt to be hard, and if it could be used for steam making and other purposes the result would be many thousands of dollars saved each year. The use of softeners and similar apparatus seems to have solved this problem, so far as the inventor and manufacturer are concerned, hence it only remains for the consumer to adopt them and profit thereby. Many plants are already supplied with well water that is used for manufacturing purposes, but water for the boilers is still purchased of the local company. This seems to be wrong, for having invested money to secure water for a portion of manufacturing needs, the service ought to be extended to cover the whole, and it can be without ruining the boiler by adopting some softening system.

An important consideration is that certain types of boilers cannot be successfully used with bad water, because the resulting scale will soon render them unsafe. Some of these boilers are very efficient when new and clean, hence if they could be kept so it would save a large amount of money annually. If impure water is used it becomes necessary to adopt a type of boiler that can be cleaned easily, and this is usually inferior when its steaming capacity is considered, and unsatisfactory when its efficiency is compared with others. Where a water-softening apparatus is installed, these objections are eliminated, and the engineer of a plant can adopt a type of boiler that will evaporate the most water per pound of fuel. This will not only produce power at low cost for fuel, but at the same time permit boilers to be used that occupy a minimum of floor space. When a new plant is designed, or an old one remodeled, this point ought to be thoroughly investigated. In a majority of cases it is possible to locate water-softening apparatus where it will not occupy room to the exclusion of other machinery. A square hollow pier may be built in the boiler-room and carried up to the roof. The lower part of it may be used to store oil, packing, etc., and as every plant ought to have a room devoted to this purpose, the pier provides it and supports the apparatus also. The tanks may be housed to protect them from the weather, and the heat from the boiler-room keeps them from freezing in winter. If there is absolutely no floor space available for this purpose, the tanks may be supported upon iron girders resting upon the side walls of the room.

LETTERS ON PRACTICAL SUBJECTS

PECULIAR BEHAVIOR OF TUNGSTEN LAMPS.

A manufacturing concern which hired electricity for lamps and motors with the building in which it was domiciled had so much trouble with the service furnished by the landlord that it decided to throw out the 220-volt service supplied by the latter and to use central-station energy. This necessitated a substitution of 110-volt for 220-volt lamps, and an enterprising electrical supply man interested the concern in tungsten lamps. These lamps were eventually put in upon a non-renewal plan, breakage to be borne by the purchaser, and no guarantee whatever given as to life. Twenty-five lamps were installed and before they had been in use three weeks five had been replaced on account of broken filaments. This high breakage percentage was duly reported to the head of the concern, and the writer chancing to be in the office when the report was brought in suggested that before the new lamps were thrown out, as the head of the concern hotly ordered, that a little investigating be done to ascertain the cause of the tremendous breakage. As a consequence of this recommendation, the writer was requested to do the investigating. The first question asked revealed a very interesting clue. It was ascertained that all the breakage had taken place in two of the lamp fixtures, and that these two fixtures were located in the private offices of the company. Further tracing of the matter developed the fact that the fixtures upon which the breakage occurred were ceiling clusters of five lamps each, and two fixtures in each cluster had flexible cords leading down to desk lamps. The other fixtures in which no breakage had occurred were in the main business office, and the clusters of five lamps each were supported from the ceiling of the office by means of fancy antique chains, each about 2 ft. long. The feed wires were semi-concealed by being woven into the chain links. Fig. 1 shows the manner in which the lamps which failed were put up. It will be noted that the lamp fixture was attached directly to the ceiling of the office, and, the building being of slow-burning construction, the location of the lamps chanced to be such that the fixture was attached direct to the 4-in. planking which formed both the ceiling of the office and the floor of the room above. The manner of attaching the fixture is shown at *A*, and the cause of the lamp breakage was still further explained when it was discovered that the portion of the floor immediately above the office was used as a shipping or packing-room in which heavy boxes of machinery were frequently packed, cased and prepared for shipment to distant points. As such shipments required very careful packing it is not to be wondered at that a large packing box should occasionally be allowed to slam down upon the floor with tremendous force while being up-ended to apply the iron strapping. It is also not to be wondered at that the lamps broke in this fixture. The wonder is that any lamp could stand the racket. Fig. 2 shows the manner in which thes lamp which did not break were attached to the ceiling. The connecting link was simply a piece of chain, but it somehow seemed to absorb the shock received from the floor above, and not a lamp broke in any of the chain-suspended fixtures. But it was also true that no 1500-lb. packing boxes were ever up-ended on the floor above the chain-suspended lamps. A cure was found for the lamp breakage in a very simple manner. The lamp fixture was removed and attached to a pair of very small steel rods, each about ⅛ in. in diameter, placed in holes bored through the beams by means of a boring machine driven by a crank on the end of a pole. The rods, or wires, were slipped through the holes in the beams and nuts were screwed home on either end of the wires, thus making them hang taut. It will be easily seen how the shocks from heavy packing cases failed to reach the lamps when they were suspended from the wires. The shocks were absorbed by the tightened wires. There are, of course, many other ways of accomplishing the same result. Much time and money might have been saved had the owner purchased any of the many shock absorbers on the market.

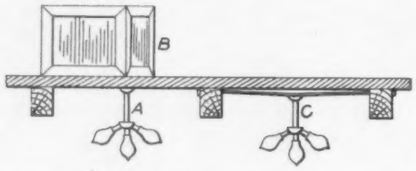


Fig. 1.—Tungsten Lamp Breakage and Cure.

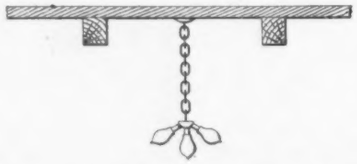


Fig. 2.—Satisfactory Tungsten Lamp Fixture.

Scranton, Pa. H. Dixon.

SPLICING WIRES ON ARMATURE AND FIELD COILS.

The writer, while in Toronto recently came across a shop kink which will doubtless be of interest to electrical men who have burnt armatures and field coils to repair. The broken or burned-out wires are repaired without removing them from the armature of field coil by means of butt-end soldering. For instance, if a splice is to be made on a damaged armature coil, the faulty wire is raised a little way out of the slot and the insulation scraped off for a couple of inches. The ends of the broken wire are then scraped or filed off smoothly and a piece of wire cut to fit the gap. The wire is butt-ended with the armature wire and the ends heated until red hot by means of a blow torch, the adjacent wires being protected by asbestos of fiber barriers while this heating is being done. When the proper temperature has been attained, a little borax is used as a flux and some silver solder is applied. The other end is soldered in the same manner and when the splice is complete, the bare wire is wound with silk. The latter does not require as much space as insulating tape and after the whole has been shellacked the wire may be hammered down into the slot again. Of course, it does not fit as snugly as it did before; but between pulling the entire winding apart and employing the method suggested, the latter not only answers the purpose as well, but saves considerable time and money. It is possible to splice field coils in the same way and the ends of successive reels of wire. Silver solder is composed of silver, copper and zinc; the silver imparting to the mixture strength, malleability and protection from oxidation; the copper giving it tenacity and malleability and the zinc fusibility.

Albany, N. Y. Jackson Walters.

NOTES ON CONDENSERS IN CONNECTION WITH SMALL STATIONS.

Although in the majority of cases condensers can be used with advantage in connection with reciprocating engines, and especially with steam turbines, there are numerous instances, especially among smaller stations where, owing to the load factor or the small maximum output of the plant, it is questionable whether the added complication and capital charge of the condensing plant are warranted. This point cannot be definitely settled without taking many factors into account. The chief considerations in determining whether or not the plant should operate condensing are the load factor—that is, the number of horse-power hours per year divided by 8760 times the maximum horse-power, and the cost of the condensing water. In many of the small stations the load-factor is so low that, even with an unlimited supply of condensing water, a condensing plant would hardly be profitable. On the other hand, with a high load-factor, the saving which may be effected by the use of a condensing

plant would be greater than the cost of the best water-cooling apparatus obtainable. It is advisable where the load factor is low to keep down the capital cost of the plant, even if the power taken by the plant is increased somewhat. If the load factor is high the running costs are of importance, so that more can be expended on the plant in order to reduce these; but unless it is possible to effect a saving amounting to more than 10 per cent of the cost of such a plant, it will be inadvisable as a general rule to install condensing apparatus, since this amount would be approximately that necessary to cover interest, depreciation, repair and other charges.

It is, of course, possible by the installation of a good condensing equipment to increase the maximum output of non-condensing engines by about 20 to 25 per cent, and there may be cases where this would be a valuable consideration, but unless the load factor exceeds 10 per cent, and abundant condensing water is obtainable at small cost, the installation of a condensing plant will generally be found to be unprofitable.

The type of condenser which it would be best to employ would depend principally upon the quality and quantity of water available, so the choice would probably narrow down to a single type. The station manager would, therefore, have no choice in the type of condenser, but in the operation of the auxiliaries the question of whether these should be steam or electrically driven would have to be threshed out. Although the relative efficiencies of the different methods of driving would have to be taken into account, it would also be necessary to consider the question of continuity of operation, since loss of vacuum might have serious consequences. It has been contended that the possibilities of failure are less with steam-driven than with electrically driven auxiliaries, and that with the latter method the number of steps from the steam to the applied power in which an interruption is possible is greater with the electrically driven apparatus than with steam-driven machines. The operator must not lose sight of the fact, however, that steam-driven auxiliaries require from 50 to 100 per cent more steam than that taken by electrically driven apparatus. Some of this is counterbalanced, to a great extent, by the large percentage of the total heat of the steam which it is possible to return to the boiler through a feed-water heater. In some instances, where the steam is not required for heating the feed water, the steam-driven pumps are connected to the condenser, thereby effecting a saving of 10 or more per cent in the steam consumption; but unless the condenser is of ample capacity this procedure is not advisable, since it necessarily limits the amount of steam which can be condensed from the main engines. The common arrangement of passing the steam from the auxiliaries through a feed-water heater is based upon good engineering practice, and should be adhered to where steam-driven auxiliaries are employed.

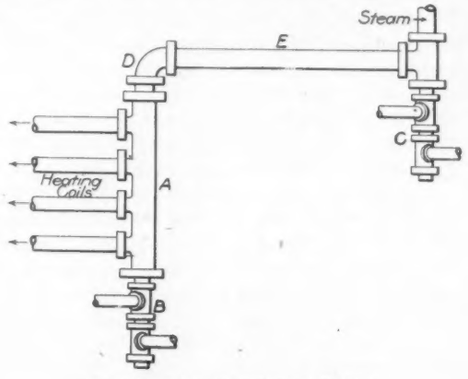
The use of the exhaust-steam turbine for augmenting or improving the efficiency of a given reciprocating-engine plant may have a bearing on some situations. The installation of such a unit may be occasioned by a desire to increase the capacity of a plant where the engine is of a good design, or there may be a possibility of bringing up the plant efficiency of a poorly designed installation. Small non-condensing engines may be changed over by this means, and the water rate reduced from 30 lb. to 35 lb. per kw-hour to 15 lb. or 18 lb. In other words, with the same fuel expenditure and water, a net increase in output of from 80 per cent to 100 per cent may be realized, depending upon the size of the units. In addition to the economies that may be effected by such an arrangement, there are other certain inherent advantages. During periods of light load the turbine may be cut out and the engine connected directly to the condenser so that a fairly high economy may be obtained even though the whole plant were underloaded. It is also possible to feed live steam directly to the turbine through a reducing valve in order to supplement the normal supply.

The installation of the low-pressure turbine would necessarily mean the installation of a good condensing plant. It is not often appreciated that there is as much available energy below the atmospheric pressure line as there is above, and the exhaust-steam turbine is capable of using this low pressure very much more effectively than a reciprocating engine. A 500-kw exhaust-steam turbine, with steam pressure at 15 lb. per square inch absolute, and operating on a vacuum of 28 in. at the turbine, requires about 33 lb. of steam per kw-hour at full load and about 40 at half load. In estimating the power available for a plant of this kind allowance should be made for drop between the engine exhaust and the turbine.

COLUMBUS, OHIO. SAMUEL LOVELL.

DRAINING STEAM PIPES.

Every steam pipe, be it for supplying steam to an engine or for heating purposes, should be so planned that the water of condensation may readily drain off by gravity. To secure this it is, of course, necessary that adequate means be provided for the escape of the water of condensation, and the pipes must be so arranged that this will drain toward the outlet provided and not be caught in pockets or other low places in the piping. The first question which arises is: Shall the pipes be inclined toward the boiler or away from it? In some piping systems it is possible so to arrange matters that the condensation will all run back into the boiler, thus giving a very simple solution to the whole problem. This method of pipe drainage is followed by some engineers, but the writer passed through several experiences some years ago which converted him unalterably toward



Draining Air from Steam Pipes.

the drain-away-from-the-boiler method. In two instances at least the toward-the-boiler drainage resulted directly in the breaking up of medium-sized engines by water which was carried over with the steam, notwithstanding the system of drainage. Another instance resulted in poor service in heating coils which were supplied by steam lines thus drained. In either case the direct cause of the trouble seemed to be that when the steam during its passage through the pipes reached a certain velocity the condensation was held in the pipes by the friction of the steam flowing in the opposite direction. When the condensation in the pipes reached a certain amount, the cross-section of the steam passage became reduced so that the velocity of steam flow was increased to a rate which caused it to pick up the condensation and force it through the pipes in solid slugs, to the utter demoralization of engine and heating circulation.

After breaking up two 16-in. x 24-in. engines in this manner, the dip of the steam line was changed so as to take the water in a direction away from the boiler, instead of toward it, and no more trouble was experienced by water being carried over into the engines. When the engines were damaged there was a separator of usual capacity in the steam pipe just alongside of the throttle, but when the water rushed over through the long pipe, the separator was flooded and the condensation passed right into the engine cylinder, breaking off the cylinder head and doubling up the connecting rod like a letter "S" so great was the quantity of water forced suddenly into the cylinder.

There is another form of steam-pipe drainage which is fully as important as condensation removal, and that is the removal of air from steam-heating circulation pipes. Air removal has been found so important that it is made a regular part of steam-heating installations, as shown by the presence of a

thermo-valve on every steam radiator. These valves act like some types of steam traps, and no steam-heating installation is considered complete without one of these automatic air valves on each radiator. It is not usual, however, to find them attached to heating coils in mills and factories, but experience has shown the writer that they should be universally applied there, as well as to radiators. The accompanying illustration shows the application of these valves to overhead coils which failed to give the heat they should, and the application of the valves is shown in several ways, as it was found necessary to attach them in different parts of the factory in question. The fact that these valves were thus applied to an overhead steam-heating lay-out need not lead the reader to imply that they should not be attached to wall coils when necessary, but the peculiar conditions under which overhead pipes work lead them to be particularly liable to air trouble. The branch or manifold being horizontal, and the feed pipe being also horizontal, permits air to collect alike in all the pipes, when in a wall coil it would only gather in the upper pipe or in the steam-supply pipe, as the arrangement thereof might make possible. The header or manifold is represented at *A*, and at *B* the engraving shows the plug removed from the end of the manifold and a nipple and a couple of tees to which the air valves are attached, as shown. Some of the coils were satisfactorily drained of air with the valves connected as shown at *A*, but other coils seemed better drained when the valves were connected at *C*, the air valves being connected to a little dead-end in the steam pipe which supplied the coils. In one instance the valves did not work well at either *B* or *C* and they were attached at *D* with very satisfactory results. In another instance the air could not be gotten rid of by any of the means described and it was necessary to break a tee into the steam pipe at *E* and extend a pipe vertically with the air valves on top of the vertical pipe. This answered well and all the air was trapped into the vertical riser and passed direct to the air valves, which removed it in short order. The Paul system consists in tapping the supply pipes as described, then connecting all the air vents, without the air valves, to an air pump which exhausts from the pipes every trace of air which shows itself in the circulation. With this system satisfactory heating can be done with a pressure less than atmospheric in the heating pipes, and for this reason it is called a vacuum system. Should a leak develop in the piping where this system is used, there will be no signs of steam or water. Indeed, nothing can come out of the pipes through an ordinary leak, for the air pump is pulling at the pipes all the time so that when a leak does occur air passes into the circulating pipes instead of steam or water coming out. There is seldom any trouble from air-bound pipes or from water-hammer when such a system is used. The scheme has, however, one disadvantage. The pipes, if exposed, are liable to be split by the freezing of the condensation much quicker than in an ordinary pressure system of heating.

South Bend, Ind. James F. Hobart.

REINFORCING ENGINE FOUNDATIONS ON SOFT SOIL.

In locating power stations close to sources of cheap water supply, very often difficulties are encountered in the shape of soft earth, etc., which render it necessary to use some kind of reinforcement for the engine foundations. Reference to the cross-sectional elevations of large power houses which appear from time to time in the pages of the technical press and which are located near or on rivers will show the elaborate precautions taken to avoid vibration in the engines due to the character of the ground on which they are erected. It is seldom, however, that small units need to have their foundations reinforced, especially after erection, so that the following account of what was done to stiffen the foundations of a 150-kw, direct-connected set located in a Western city may be instructive. The bank of the river where the station is located is composed of sand and silt deposited during flood periods, and although the ground level is 20 ft. above normal river level, the soil is composed of alternate layers of loam and quicksand with occasional layers of good, sharp building sand down to a depth below that of the river bed. The mixture has a sponge-like texture and does not settle, and large sections are subject to vibration in a mass. When the plant under discussion was erected the building walls were carried down 12 ft. to 14 ft. below ground to a layer of building sand. The footings were spread to an unusual extent so as to distribute the pressure over a wide area. In the engine-room difficulty was experienced with the foundations for the generator sets. The concrete was carried down 12 ft. to the same level as the building foundations and the footings were spread much in the same manner. When a 150-kw unit was started, however, on its trial run, it was noted that when the engine came up to speed the machine and foundation rocked on the soft soil. This rocking increased as the engine was kept in operation, the motion consisting of a movement or rocking longitudinally across the center with a vertical movement at either end of from ¼ in. to ½ in. As the engine was a high-speed machine, and well balanced, it was evident that the stability of the soil under slight vibration had been underestimated by the engineers and as the rocking became dangerous, the unit was shut down. The problem then was to provide a suitable foundation for the engine and an effort was made to ascertain the possibility of reinforcing the foundations as they had been installed, in order to avoid tearing them all out, as all the foundations had been completed and other units were being erected. A hole was dug from 10 ft. to 12 ft. below the base of the foundation to ascertain the bearing capacity of the underlying strata. A hole several feet in diameter was dug without difficulty, the sides of the pit standing without support and investigation showed the soil to be of the same character to a point 25 ft. below the ground level, where another layer of coarse sand of a better quality was encountered. It was decided by the engineers working in collaboration with the engineers of the station to extend footings from the corners and sides of the present foundations down to this layer of sand in an attempt to hold them rigid and avoid reconstructing them. Excavations were made from the basement level to the sides and corners of the foundation of the 150-kw unit and holes bored thence to points about 12 ft. below the base of the foundation until the layer of sand was encountered. The holes were built of a stem of 2½-in. pipe with two sets of auger vanes, one 8 in. in diameter at the tip and the other 15 in. in diameter about 15 in. above the tip. At the upper end of the pipe a handle of the usual type was fitted by means of which the auger could be turned into the soil and lifted out periodically, bringing large masses of soil at a time. The auger was turned into the soil until it clogged and was then lifted out by means of block and tackle. The holes were bored rapidly in this way and owing to the nature of the soil maintained their shape. In filling the holes with concrete four pieces of 1-in. pipe were first inserted for reinforcement. These pipes also served for pumping a rich mixture of cement to the bottom of the openings that spread into the sand giving a wide bearing footing. The concrete used to form the piles was very rich and was tamped and carefully rammed, after which the tops were capped with a square block which projected under the engine foundations. After permitting the concrete to set for a number of days, the space between the block and the foundation was filled with grout so as to form an effective union. The engine was again started a few days after and ran without causing the slightest vibration and without any perceptible rocking. The other foundations were then similarly reinforced. Seven piles were put under the edges of the 150-kw unit's foundation.

St. Louis, Mo. H. G. Hall.

DIMINISHING TRANSFORMER LOSSES.

As is probably well known, there is always a continuous loss in the primary coils and core of a transformer whether the secondary is carrying any load or not. This loss, although small in well-designed transformers, is continuous and amounts to considerable in the year. There have been numerous schemes and devices proposed and used for diminishing the loss, such as cutting out the transformer entirely when it is not in use, but

in actual practice none of these is employed. One method of interest is to divide the primary and secondary of each into two equal parts and to couple them in multiple for full load and in series for small loads. The voltage transformation ratio, of course, remains the same; but the induction will be reduced to a half for the series connection, the loss due to hysteresis will be reduced more than half and that due to the heating of the coils, although increased considerably, is small in value, so that there is an appreciable gain in economy. A similar scheme, applicable to three-phase circuits only, consists in connecting the three coils first with the end of one to the beginning of the next, or connecting them in delta and then changing them to star connection. In the first case the voltage per coil will be 73 per cent greater than in the second, so that the delta connection may be used for full loads and the star connection for light loads. The change must be made simultaneously in both the primary and secondary circuits so as to retain the same ratio of transformation.

BUFFALO, N. Y. HERMAN MEYER.

PECULIAR ELECTRIC FIRE.

To many the rules and regulations formulated by the Underwriters' National Electric Association, intended to safeguard electric circuits, apparatus and operators whose occupation brings them in close contact with such apparatus and circuits, appear entirely too stringent. In not a few cases an impression prevails that the Underwriters seek to guard against visionary dangers which, while they may possibly occur, are likely never to do so. To one acquainted with the procedure followed by the organization mentioned the baselessness of such a supposition is apparent. The following incident, which occurred not very long ago, should also serve to show that the rules in the Code do not cover every possible source of danger. At a Canadian mill the energy is received from a 2200-volt, 60-cycle, two-phase transmission line. For some unknown reason, attributed to a defect in the transmission line, the circuit was interrupted for a moment, and the motors in the mill slowed down. The circuit was again made, however, without notification to the engineer of the mill, and as a result several coils were burned out on the synchronous motor of the motor-generator set in operation, and a short-circuit of such intensity set up that when the main switch was opened on the switchboard to protect the motor, the switch itself was short-circuited and a fire started. Strange as it may seem, the short-circuits spread to all sections of the board and passed thence to the cables at the rear, burning the insulation on the wires. The room was soon filled with flames, which ate their way to the wire tower, seriously damaging the entire electrical equipment. If, as a result of the above accident, rules were to be formulated to cover the conditions encountered, it would be necessary that all rooms containing switchboards or other apparatus of high current-carrying capacity should be thoroughly fireproofed and isolated from all adjacent rooms in the building. Furthermore, a ready and safe means of controlling high-tension current from outside of the property would have to be provided, possibly in the shape of a disconnecting switch by means of which the circuit could be interrupted in case of trouble. It would appear that with all of the safety devices on the market such an accident would be impossible, but unfortunately fuses do not always blow or circuit-breakers open when they should, as everyone who has had experience with electrical machinery is aware. Should, however, the Underwriters attempt to forestall a like accident by enacting rules to meet just such emergencies, there would be considerable opposition to such regulations.

CHICAGO, ILL. JAMES SCOTT.

ELECTRICITY IN CONSTRUCTION WORK.

The writer was very much interested in an article on "Electricity in Construction Work" which appeared in your paper some months ago, and while it cannot be denied that contractors have been slow to adopt the electric motor for hoisting purposes, still the fault may not be entirely theirs, and doubtless rests with central-station companies, who hedge their contracts with so many stipulations that the average builder does not care to accept them, or who require the contractor to bear most of the expense in running feeders to reach him. Doubtless the small contractors and builders in the East lack the incentive to adopt the advanced methods of construction which the use of electricity would necessarily involve. The large contractors, on the other hand, must adopt all labor-saving appliances and methods of performing work quickly, in order to get contracts in the first place, and to realize a fair share of profit on the risk in the second place. There is no doubt but that the donkey engine has won a place in the affections of contractors of the old school, because of its reliability and its inherent advantage of withstanding very rough usage. However, electric motors have been used for hoists for many years, and the application of electricity for this purpose is not as recent as some of your articles would imply. The writer recalls an interesting application of a motor to building operations over 10 years ago when the United States Mint at Denver was being erected. This structure has granite walls and steel columns and beams, and much of the masonry and frame work was put in place by a special traveling derrick, which moved on an outside surface track and was operated, if my memory serves me, by a 25-hp enclosed motor of a type used on street railways. The derrick consisted of timber shears high enough to command the tops of the walls, which were pivoted to the deck of a timber platform counterbalanced with granite blocks and supported on the wheel base. The shears had an overhanging cross head from which a wire-rope hoisting tackle was suspended. The main posts had transverse cross bracing in the plane of their axes, and were trussed by iron posts and rods in vertical planes at right angles to them. They were set to overhang the load slightly, and the latter could be swung several feet by raising or lowering the top. This motion was used for setting the granite blocks, and was secured by operating an eight part wirerope tackle attached to the back guy. For moderate loads close to the base the shears were independently stable, but for heavy loads or a wide swing, the top was guyed by wire ropes to the rear and lateral anchorages. The derrick track was about 6 ft. from the building and between it and the wall was a 2-ft. gage track. The hoisting machinery consisted of a double-drum engine with two capstan heads bolted to the main timbers of the platform. The motor was wound for 500 volts and made 500 r.p.m. It drove a countershaft through gears which reduced the speed to about 100 r.p.m. It was commanded by a controller with a single lever, by which it could be started, stopped or have its speed regulated. The hoist and shear drums were operated by a single lever, which moved the countershaft back and forth between two clutches, throwing one of them into gear and the other out. By this means confusion or the possibility of accident in throwing both the clutches into gear at once was avoided. The clutch lever was provided with a stop pin, which in the first position locked the hoisting drum in gear. In its second position it locked both drums out of gear, with their pinions running loose on the countershaft. In the third position the shear drum was locked in gear. A miter gear ran loose on the end of the countershaft, and when its clutch was thrown in by the lever it operated a sprocket chain which drove the wheels of the traveler. Each drum was provided with a powerful differential brake operated by a lever. In order that they might be conveniently operated by one man, the clutch brake and controller levers were located close together. The capstan heads ran continuously and were found convenient for any light or quick hoisting, such as was necessary in setting columns. The hoist was designed to handle about 8 tons, but was capable of lifting 12 tons easily at a hoisting speed of 30 ft. The traveling speed was about 75 ft. or 80 ft. a minute.

There have doubtless been many advances made in the construction of hoists since that time, but it is a question if modern hoists are more convenient or possess more advantages than the hoist used in Denver about 10 years ago. To be sure, the mast hoists illustrated in your columns are very compact, and probably cost less than the hoist under consideration.

DENVER, COL. WILLIAM MANNING.

QUESTIONS AND ANSWERS

A three-phase, 60-cycle alternator is delivering electricity to a factory load of motors. The indicating instruments show the following readings: 325 kw, 470 amp per wire, 550 volts per phase, and 73 per cent power-factor. What is the mechanical horse-power required to deliver this output, neglecting friction, windage, etc.? C. E. F.

One kw equals 1.34 hp; hence, neglecting losses, a 325 kw output would require 435 hp. At an efficiency of 90 per cent, 485 hp would be needed.

We are operating a gas engine, using a battery of five primary cells for sparking. We have in the plant direct current at 125 volts and single-phase, alternating current at 110 volts. Can both or either of these be adapted for sparking purposes so as to dispense with the use of batteries? C. C. B.

Electricity for the sparking of your gas engine can be derived from either the single-phase circuit or the direct-current circuit. A convenient arrangement for the direct-current circuit is one involving the use of resistance connected permanently across the 125-volt mains with a tap taken off to the spark plugs part way on this resistance. Several manufacturing companies have placed upon the market small alternating-current transformers which are suitable for reducing the voltage of the single-phase circuit to the value required for spark plugs.

If two three-phase alternators are operating in parallel and the direction of rotation of one machine is reversed, why must two of the generator leads be interchanged before the machine will synchronize? If the machines have been synchronized with the lamps "bright," can they continue to be thus synchronized when the direction of rotation of both is changed? V. P.

When the mechanical direction of an alternator has been reversed it is necessary, of course, to reverse its electrical rotation if it is to be synchronized with the same machine as before. If *A*, *B* and *C* represent the phase leads, which for forward rotation appear in the order *ABC ABC*, etc., then for reverse rotation, by interchanging any two phase leads, we get the order *BAC BAC*, which appears in the same order as the preceding line read backward. If both machines are reversed in direction, the conditions and methods of synchronizing will remain unchanged.

Since sodium combines with water, why cannot it be employed to dehydrate transformer oil? S. T.

Ordinarily sodium combines violently with water and must, therefore, be kept submerged in oil. It has, however, been used as a dehydrizing agent, small quantities of the metal being added to the oil, hydrogen being formed in the presence of water and soda falling to the bottom of the solution. About three-quarters of an ounce of sodium is added to 20 gal. of oil, more being added gradually until gas ceases to be evolved. The oil should be shaken up for a minute for a period of three or four days, and it is found that the longer the oil is allowed to mature over the deposit of soda, the stronger will be its insulating powers. Oil, it is said, can be treated in the transformers themselves, the sodium being molded into sticks which are attached to wires and plunged into the liquid. This is not a preferable method, however.

We have a water-power plant containing a 450-kw and a 600-kw alternator, supplying energy at 480 volts and 60 cycles, to an industrial lighting and power load. A new electric railway in this vicinity has applied to us for a contract for supplying energy to operate its 320-hp of motor equipment over the seven miles of track now under construction, proposing to install a motor-generator set and a storage battery, to relieve our lines of load variations. Is the storage-battery arrangement a successful one, and what should be the apportionment of charges for such service as the railway company contemplates? T. L. H..

The use of the storage battery to relieve the generating station and power lines of the varying load due to the operation of the electric railway has been shown to be entirely successful. If the storage-battery equipment is to be installed and maintained by the railway company, the charge should be based upon the energy supplied by the power company at so much per kw-hour. On the other hand, if the battery is to be supplied and maintained by the generating company, it will be necessary to add to the simple energy charge items to cover the cost of investment, maintenance and depreciation of the storage-battery equipment.

Please explain a Wheatstone bridge method of testing rail bonds? N. G. W.

A rail bond in good condition will have a resistance about equal to that of 1 ft. of rail. A simple method of testing the bonds is by the use of a milli-voltmeter while the rail is in service as a return conductor. The terminals of the meter are connected across the joint; the terminal leading to the far rail-end being also connected to a movable contact on the near rail. These connections should be made through small, equal resistances, say, 0.5 ohm. The movable contact is then tapped along the rail until a point is reached where the meter reading becomes zero, indicating the resistance of the joint in terms of the length of the rail. The connection described forms a Wheatstone bridge, in which the arms are the joint, the measured length of rail, and the equal small resistances. The results will be independent of the current flowing in the rail, but care must be taken to see that the instrument indicates appreciably on the drop across the joint, in order to make sure that the zero reading obtained is not due to the absence of all indication.

We plan to supply energy to a 125-kw incandescent lighting load 16 miles from our two-phase, 60-cycle, 2200-volt generating station. Would it be advisable to transform to three-phase for this transmission, and what voltage should be employed? What kind of wire would be used, and what distance and sag should be allowed between 35-ft. poles with No. 4 or No. 6 copper? R. E. L.

For this transmission a potential of not less than 6000 volts should be used to keep the line loss within 10 per cent, with conductors of No. 4 copper. However, 11,000 volts to 16,500 volts could be employed to advantage, as transforming apparatus will be required in any case. If the same voltage and size of conductor are used, the line loss for a four-wire, two-phase circuit will be the same as that of a three-wire, three-phase circuit. Step-up and step-down transformers will be necessary with either arrangement, and as these can be obtained for converting from two-phase to three-phase, and vice versa, without additional cost, the three-phase line will have the advantage of saving the copper and insulators for one wire. The distant distribution should be made from the two-phase secondaries. No. 4, hard-drawn, bare copper wire may be strung with 2-ft. sags in 200-ft. spans, using 26 poles per mile. A ground wire carried along over the transmission line will aid in protecting it from lightning disturbances.

In designing a series transformer to increase the range of an alternating-current ammeter, what value should be taken for E, the electromotive force, in the equation

$$E = \frac{4.45 \times B_{max} \times f \times N}{10^8}$$

when B_{max} is the maximum instantaneous value of the flux density, f is the frequency in cycles per second, and N is the number of turns? C. T. V.

The simpler consideration in applying the above formula to the problem of the series transformer is to take it with reference to the secondary circuit, which contains the instrument windings. That is, design the transformer from the secondary end, so to speak, letting E represent, in volts, the e.m.f. necessary to send the required secondary current through the secondary winding, ammeter, wattmeter current coil or whatever other apparatus is to be included in the secondary circuit. For a series transformer the value of B_{max} should be taken very much lower than in general transformer practice; 1000 lines per square centimeter may be used as an average figure for this purpose. It is equally correct, of course, to take E as the voltage across the primary coil necessary to send the "equivalent" secondary current through the "equivalent" resistance in the secondary—the "equivalent" current and resistance being obtained by multiplying the respective secondary current and resistance by the ratio of transformation. The latter method, however, involves the confusion of translating the terms several times without advantage. After designing the magnetic core with respect to the secondary, the primary is given the suitable number of turns to effect the proper ratio.

Central Station
Management, Policies and Commercial Methods

PUSHING TUNGSTENS AMONG SMALL MERCHANTS IN BALTIMORE, MD.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., is making every effort to induce the small merchants to use electricity for lighting and to that end has offered to furnish and install one four-lamp, or two two-lamp, or four one-lamp fixtures equipped with 60-watt, frosted-tip, tungsten lamps and prismatic glass reflectors for $15, payable at the rate of $1.25 per month. In addition the company agrees to maintain the lamps for one year free of cost. Accompanying the letter making the offer is an illustrated circular showing the various fixtures mentioned.

BRITISH RESIDENCE RATES.

In a report on rates for electrical supply, Mr. A. B. Holmes, consulting electrical engineer of Liverpool, England, called attention to a method of charging which has been adopted in Norwich for private houses, namely, a fixed annual charge of 12 per cent on the ratable value of the house, and, in addition, a charge of 2 cents per kw-hour as registered by the meter. The reduction of the supply to private houses arising from the adoption of the metallic-filament lamp can, Mr. Holmes says, be met by encouraging consumers to install the electric light throughout their houses (instead of only partially, as is frequently the case), and also to make use of electric radiators, irons, kettles, cooking apparatus, and other domestic appliances which are supplied at power rates, but the use of which has hitherto been almost prohibited by the cost of a second meter and independent system of wiring for the power-rate supply. The proposed new alternative method of charging renders a second meter and wiring system unnecessary, and affords the greatest possible inducement for the development of the domestic uses of electricity. The engineer, therefore, recommends the trial for a period of 12 months of the following optional method of charging for private houses of not less than $100 ratable value: A fixed quarterly payment of 3 per cent on the ratable value of the house, and a charge of 2 cents per kw-hour on each unit as measured by the meter. Already, to facilitate the use of electric light in small houses prepayment (shilling-in-the-slot) meters are supplied when desired. The charge for energy so supplied is 8 cents per kw-hour, which includes meter rent and maintenance.

EXPERIENCE WITH TUNGSTENS AT SOUTH ST. PAUL, MINN.

When the tungsten lamp was first seriously introduced it was felt that of all the central-station companies who could ill afford to consider the installation of such lamps on their circuits, it was the small companies operating in cities of 5000 inhabitants or less. That this fear is unfounded is well attested by the experience of Mr. E. W. Erid, general manager of the South St. Paul Electric Light, Heat & Power Company, of South St. Paul, Minn., who has pushed the sale of tungstens quite energetically and watched results closely. As a specific instance of how the matter worked out, the case of a complaining customer, a butcher, may be cited. This individual always found fault with the amount of his lighting bill and the poor quality of his light, even going so far as to threaten to install a gasoline plant. His lamp installation comprised 12 ordinary carbon-filament lamps requiring an aggregate of 660 watts and his monthly bill was generally between $3 and $4. He was finally induced to use six 100-watt tungsten-filament lamps and although the bills for the next two months were $9.78 and $10.34, no complaint was made regarding the cost or of the quality of the light. It has been found that with the better light, customers use electricity longer morning and evening and even use it during the day instead of taking advantage of the daylight, because in winter daylight is only comparable to the light of large tungsten lamps for a few hours. Moreover, in many locations the quality of the daylight is such that it never is as good as the light from a large tungsten lamp. The company finds that despite the introduction of higher efficiency lamps its income is increasing.

TOASTER CAMPAIGN IN DENVER.

The Denver Gas & Electric Company, as previously noted in these columns, has made plans to introduce 1000 General Electric vertical toasters among its residence customers this year. Last fall some 200 of these toasters were purchased and put out on trial. Of these 40 per cent were retained by the persons first trying them. While this percentage may seem low as compared to percentages of electric flatirons, which are retained when placed on trial, it must be remembered that the toaster is a comparatively new and unfamiliar device. Both the solicitors and consumers have yet to become generally acquainted with it. Mr. C. N. Stannard, secretary of the company, says that in the early part of the company's flatiron campaign no better percentage was obtained than 40, although the percentages are much better now, and the company has met with good success in placing flatirons, having over 7000 in service.

ELECTRIC POWER AT MONTPELIER, VT.

In a recent address before the Board of Trade of Montpelier, Vt., Mr. J. E. Davidson, president of the Consolidated Lighting Company of that place, gave some interesting information concerning the development of the motor load of his company. In 1905 the Consolidated Lighting Company had 758 hp in motors connected on its lines, while on Dec. 1, 1909, there was 3350 hp in motors, or together with a subsidiary property, the company was serving a connected motor load of 4648 hp. Five years ago granite manufacturing sheds operated with about 30 hp each; this increased to 50 hp, then 70 hp, and now 100 hp is the usual installation. To be able to deliver 4650 hp requires a capacity of over 10,000 hp in steam and hydraulic machinery, and in order to keep apace with the demand for power the capacity of the company's Bolton Falls plant has been increased to 2600 hp, the steam capacity tripled, fireproof transformer houses erected in Waterbury and Barre, not to mention the numerous secondary extensions for power, arc, domestic and commercial lighting. Every new power customer means an added investment of about $200 per horse-power connected. The expenditure starts at the generating stations and goes on through transmission line, transformer house and equipment, auxiliary steam apparatus, distributing lines, transformer, meters and other apparatus at point of load.

At first, in the solicitation of power business, it was necessary to offer a long argument on the economy and advantages of electric power versus steam; now few manufacturers consider a steam equipment for a moment. A steam equipment for a granite plant with a power installation of 100 hp costs about $11,000, while an electric equipment, including heating plant, does not cost over $2,000, the operating cost is 40 per cent less, and the motor drive has the advantage in economy of floor space, low repair cost, cleanliness, noiselessness, flexibility, overload possibilities, elimination of fire risk, etc.

Following is a comparison of the connected load in motors

served by the Montpelier plant and that of several large manufacturing cities in Massachusetts, the third column giving the ratio of population to motor load:

City.	Population.	Motor hp.	Number people served by 1 hp.
Haverhill	37,000	1908	19
Lowell	110,000	6435	17
Lynn	89,000	3211	24
Springfield	86,000	3797	22
Montpelier and vicinity	29,000	4648	6.2

Mr. Davidson stated that his company employs in Montpelier 23 people six months in the year and 17 for the remainder, with a pay-roll of $20,954 per annum. The total number of men employed on all of the Consolidated properties is 36, who receive $40,000 per annum. The taxes paid are 2½ per cent of gross earnings, and the freight paid to local railroads in the past two years for miscellaneous material and coal has amounted to $48,000.

Power for manufacturing purposes is sold in large quantity for 2 cents per kw-hour for eight-hour daily service. The rate for commercial lighting is 6⅞ cents per kw-hour, and for residence lighting, 10 cents per kw-hour. Window and sign lighting is on a flat-rate basis, equivalent to 5 cents per kw-hour, the company turning the lights on and off.

COST OF RUNNING ELECTRIC VEHICLES.

The Waverley Company, in a pamphlet recently issued, gives some interesting information concerning the cost to users of Waverley electric vehicles. A number of questions were submitted to users of these vehicles requesting information as to the average monthly bill for electricity, approximate monthly distance traveled, experience with life of the battery, monthly allowance for battery renewals and some other queries. The replies to the question as to cost for electricity were divided into two classes, for vehicles kept in private garages and for those kept in public garages. It was found that the cost for private charging in the State of Indiana averaged $6.37 per month; in the Middle West States, $5.67 per month; in the Eastern States, $4.11 per month; in the Southern States, $6.07 per month, and in the States west of the Mississippi, $4.32 per month. The cost of storage, service and current for vehicles kept in public garages averaged for the whole country $21.50 per month. Some typical reports on costs are printed with the names and addresses of the owners.

In answer to the question as to the monthly distance traveled 12 owners reported more than 500 miles per month, the highest being 750 miles. The average for the State of Indiana was 352 miles; for the Middle West, 321 miles; for the Eastern States, 390 miles; for the Southern States, 331 miles, and for the States west of the Mississippi, 488 miles. The answers to the inquiry for experience as to the life of batteries gave an average life ranging from two years in the State of Indiana to two years and eight months in the States west of the Mississippi. The average monthly cost of battery renewal was $5.73 in Indiana, $5.01 in the Middle West States, $4.85 in the East, $5.88 in the South, and $4.44 in the States west of the Mississippi.

PUBLIC REGULATION OF BRITISH LIGHTING PLANTS.

By Glenn Marston.

It is a peculiar fact that the most rigidly regulated public utilities of Great Britain are the ones which are the least satisfactory to both the stockholders and the consumers. The large transmission companies are the only ones which give an approximation of "service," as it is understood in its broad sense in America, and it is in the territory of these companies that the lowest rates also prevail.

There are two ways of establishing an electrical undertaking in Great Britain. One is by obtaining a "provisional order" from the Board of Trade, which is issued subject to the various general acts of Parliament referring to the manufacture of electric energy. The other is through obtaining a "power act" for the establishment of an undertaking too large to come within the terms of existing legislation.

A provisional order permits the organization of an electrical undertaking subject to the jurisdiction of a single group of local public officials, and does not permit the promoters to go beyond that jurisdiction except under practically prohibitive terms. A provisional order is granted to a company for 42 years, at the end of which period the municipality, or "local authority," can buy the plant at the then physical value of the property. In case the local authority does not purchase at the expiration of the 42-year period it may purchase at the expiration of any succeeding 10-year period.

On the other hand, the local authority may obtain a provisional order which is perpetual, this being the greatest advantage held by municipal over private plants in Great Britain. In addition, any private company must get the consent of the local authority to apply for its provisional order, and if this consent is withheld the order is not granted. In many cases where municipal gas plants exist companies have not been given orders for the establishment of electrical plants because such a plant would compete with and injure the value of the plant which the taxpayers had built.

The effect of the 42-year limitation has been to restrict the development of privately owned central stations to only the profitable districts, and as all construction is underground, to bring up capital cost to a very high figure. There is no incentive for the company to keep its plant in first-class condition for some time prior to the expiration of its order, and none whatever to maintain an efficient plant during the 10-year periods.

In many cases, since the organization of the electricity supply companies, the municipalities (having failed to do a profitable business themselves) have leased their plants to the companies. This method provides excellent operating conditions for the companies, for they are saved from finding the capital necessary to build such plants, though they must pay interest charges on a construction cost much higher than that of a similar plant privately built.

Such operating contracts can be made on terms which will affords every inducement to the company to give good service and result advantageously to both company and consumer. As a usual thing the local authority finds the money for up-keep, so that extensions and renewals are not skimped, and the lease is usually based on the investment, the company meeting the interest and depreciation cost in a predetermined manner.

As to rates, provisional orders specify nothing but the maximum, which is usually 16 cents per kw-hour. As all rates are lower than this, the specification of a maximum rate is merely formal. On the other hand, it is common for companies to make bargains as to rates with the local authorities in order to secure their consent to the granting of the order.

By far the most important phase of public regulation, however, is that of the various "power bills," which are grants to companies to operate in extended areas. The power bills are practically perpetual franchises, each bill relating to an individual company. The most liberal of these bills are those granting rights to the electricity supply companies in the vicinity of Middlesboro and Newcastle.

These bills, while protecting the public to the fullest degree, allow the companies such latitude that they are enabled to give not only the best service in Great Britain, but the cheapest as well. It is characteristic of the British policy of regulation that it does not attempt to interfere with questions of management. The attitude of the power bills is, throughout, one of encouragement to the greatest exercise of executive ability, giving a proportionate reward for the display of such ability.

England appears to have realized at last that an obstructive legislative policy has been responsible for the backward state of the electrical industry, and the power bills represent an attempt to encourage the development of the central station along lines which will benefit the public without preventing investors from exercising a reasonable control over their own money.

Even the transmission companies suffer greatly on account of the unwholesome effect of municipal ownership, for most of the power bills provide that the transmission companies shall not operate in cities in which there are municipal plants except by consent of the local authority. Except for this restriction the transmission companies may enter any city in their territory without local consent.

The Cleveland & Durham Electric Power, Ltd., has an act which permits it to appeal to the Board of Trade in case the local authority unreasonably withholds consent, and by threatening to appeal to the Board of Trade, a Government department somewhat similar to the Department of Commerce and Labor, this company arranged to sell energy to the municipal plant, thereby permitting the city to reduce its rates, and to get authority to do business in Middlesboro as long as the city's existing customers were not interfered with. In other cases this company, as well as others, has leased the municipal plants for long terms and given lower rates with better service, while the political complications surrounding the municipal plants have been wholly removed.

It is interesting to observe that the bulk of appeals to the Board of Trade are made by the companies, and are made for permission to improve the service or reduce the rates. The entrance of the transmission companies has lowered the rates wherever they operate, and they are being bitterly fought by the cities whose plants cannot stand any reduction in price. The Board of Trade cannot compel a rate which will not provide for depreciation and a dividend of 8 per cent, but it can permit the entrance of a new company if the existing plant will not meet the rate offered by the newcomer.

The great difficulty with the British method of regulation—particularly through the power acts—is the necessity for the companies to go into politics in order to secure the rights they desire. It is said that the cost of obtaining some of the power acts has been as high as $300,000, and that from $50,000 to $60,000 represents the expense to promoters in other undertakings which never got through Parliament at all.

It is self-evident that this huge expenditure in obtaining rights must come out of the public's pocket and that such rights cannot be secured save on a very large scale. On the whole, however, the newer policy of encouraging low rates and good service by allowing a wide margin for individual management has proved successful, and the elimination of the time-limit in these large franchises is acknowledged to have great weight when the rate question comes up.

RELATION OF ELECTRIC VEHICLES TO CENTRAL-STATION BUSINESS.

Mr. O. M. Rau, electrical superintendent of the Milwaukee Electric Railway & Light Company, gave a paper on the foregoing subject at the convention of the Wisconsin Electrical Association at Milwaukee, Jan. 19 and 20, 1910.

Mr. Rau said that load factor and dividend go hand in hand in electric lighting and power business and any load tending to reduce the prominence of the peak will do more toward the net earnings than any other kind of business that can be secured. Extraordinary efforts have been made to introduce flatirons, toasters and heating goods which are not on at peak periods; therefore, it is not surprising that the central station should welcome the electric vehicle. The power consumption of the average vehicle will equal approximately 50 flatirons. Up to within the past year the success of the electric vehicle in the hands of the average user has been anything but an assured success. This naturally prevented the general recommendation and approval of electric vehicles by the power companies. Usually when any device of this kind which consumes current receives the endorsement of the central-station manager, the consumer feels that whenever any trouble is experienced, the light and power company should remedy the trouble.

In Milwaukee matters have now reached a stage, however, so that the company feels that it can actively canvass for electric vehicle business without assuming any responsibility as to the actual operation of the vehicle. The growth of this business on central-station mains in Milwaukee for the past four years is shown by the following figures: In 1906, three customers, 2300 kw-hours gross consumption, income $200; in 1907, seven customers, consumption 5400 kw-hours, income $500; in 1908, 13 customers, consumption 12,500 kw-hours and income $1,200; in 1909, 29 customers, consumption 91,000 kw-hours, income $4,200. From installations on the Milwaukee system the following data have been obtained: The maximum bill for an electric coupé of the standard style was $48 for a month. The minimum bill was $4.75. While the average bill of 25 private garages was $7.51 per month, indicating the cost for current compares very favorably with the cost of food for a team of horses, while the expense of maintenance compares equally well with the average private stable.

Further demonstration of the electric vehicle for business purposes is desirable before the central-station man can actively recommend such equipment. Milwaukee is more or less hilly and the grades are a serious difficulty. The limited number of improved streets has also a bearing on this question. Before recommending these vehicles for business purposes a very careful investigation should be made, as one failure because of improper application will seriously set back the adoption of this class of vehicle for such purposes. The experience which his customers have had with the electric vehicle charging outfit has been very satisfactory. In the majority of cases of complaints the trouble has not been found in the charging outfit, but in the vehicle itself. Charging outfits, both for alternating current and direct current, are so simple in their operation that anyone following instructions should have little trouble. Mr. Rau favors charging at private rather than in public garages on the ground of convenience.

The question often arises whether this business is more desirable than other power business because it is off the peak-load lighting hours. To enjoy fully the convenience of an electric vehicle, no restriction can be placed on its owner as to what hours the vehicle shall be charged. The question of cost of current does not enter into the advisability of using an electric vehicle, as this cost is but the smallest part of the entire expense.

In summing up this matter, he said, there is no reason why every private vehicle in Milwaukee should not be operated by electricity; that it is good business policy for the central-station manager to use his efforts in recommending this class of vehicle for this purpose; that he cannot give any better rates for this class of service than he can for any power service on his system; that in soliciting this business he should assume no responsibility for the equipment, but should lend every assistance in locating the exact cause of trouble and in remedying the trouble, and that in the solicitation of this business he should advocate a private charging plant.

In the discussion which followed this paper several speakers agreed that the condition of roads and pavements in many cities is the greatest bar to the introduction of the electric vehicle. Mr. T. C. Martin indicated that the commercial vehicle is now receiving the most attention from central-station men as being of the most promise. He spoke particularly of the central station at Rochester, N. Y., which attends to the up-keep of vehicles in that city. There are about 20,000 electric automobiles in operation in the United States. About 4000 of these went into use within the past year.

PLANT-INVENTORY AND VALUATION.

At the Wisconsin Electrical Association convention at Milwaukee, Jan. 19 and 20, Mr. W. R. McGovern, chief engineer of the Wisconsin Telephone Company, presented a paper on "Inventories." This paper covered in a general way the methods followed in taking inventories of telephone-exchange plants in Wisconsin to determine the estimated cost of replacing the existing plants as well as the estimated present or depreciated value. Mr. McGovern's paper also contained many valuable

suggestions for electric light and power companies making such inventories.

He explained that an inventory of this character is divided into (1) the field survey and (2) the final office tabulation and computation. The field survey is made by engineers and construction men familiar with construction costs and with the particular part of the plant assigned to them. The field survey consists in securing by actual observation the amount and type of the plant. Good office records assist materially in this work.

REAL ESTATE.

In the valuation of real estate actual tape-line measurement is made of the land owned. The value is arrived at by getting the assessed values of adjacent lots similarly situated and applying a ratio which is worked out between the assessed value and the market or selling value from records of actual sale. If the property has been obtained by buying up in small parcels an addition of 10 per cent is made. This, in general, is the system used by the Wisconsin State Tax Commission. The opinion of real-estate dealers is also of value in this connection.

In the valuation of buildings, plans and details are checked against the office records, and figures are secured from local contractors on the cost of reproducing the building in question.

POLE LINES.

Standard methods of construction, where such construction is systematically inspected, assist materially in accounting a plant. For example, with certain standard constructions the number of steps of a certain size of pole will be known, as well as the length of the cross-arm braces, etc. In valuing poles and cross-arms the height and size of all poles, the number of the various sizes of cross-arms, brackets, anchors, etc., and the year of installation are indicated by code on a map of the community. On this plan note is also made of whether the poles are painted and stepped, as well as the number of vacant gains, and any special reinforcement or construction that has been installed. Where this information cannot to advantage be placed upon the plan, the particular pole or poles are indicated by reference number, and the information is written in a note book. The height and size of the poles are, in general, estimated by the man making the inventory of that part of the plant. Where there is any doubt, however, actual measurement is resorted to.

The number and kinds of wires in each span between poles are noted on the pole plan. Different kinds of drops, both working and dead, are counted, and their average length is secured by measuring a representative number of each kind. The length of all copper wire is measured by a field tape line. The length of all iron wire is scaled from the map on which it is shown.

The kind of paving on the streets and alleys in which underground conduit has been installed is also noted on a map or plan. In addition the local city records are referred to and local contractors are consulted to ascertain the cost of laying the particular kinds of pavement.

OFFICE COMPUTATION.

The plant counted and checked in the field is listed in final form in the office. To arrive at the cost of reproduction standard units which have been developed for the telephone work of this company are used. Allowance is made for extraordinary labor troubles or extraordinary prices of copper wire or other material.

After the reproduction cost of the plant has been listed, the estimate must be made on depreciation. No depreciation is figured on stores and supplies. To cover the cost of storing and handling material shipped out of the general warehouse and the cost of freight and cartage on this material in coming to the warehouse, 10 per cent is added to the reproduction value. This, of course, does not apply to material that is shipped directly from the manufacturer or jobber to the exchange.

For general office expenses and clerical labor in the construction department, and for the office work pertaining to construction estimates, a percentage is added to cover the cost of labor, board, teaming, traveling and incidental expenses. This figure is 10 per cent on outside plants and 5 per cent on inside plants. To cover depreciation on tools used in constructing the plant 2 per cent of their value per month is added to the reproduction value. Twelve per cent is added to cover engineering, supervision, interest during construction, insurance, omissions and contingencies.

DISCUSSION.

Mr. Harold Almert, of Chicago, inquired whether the cost figures taken were the costs when purchased or the cost to-day. Mr. McGovern replied that the aim is to get "reasonable cost." If prices fluctuate much over a given period sometimes a curve is plotted from actual prices and a smooth average curve taken to indicate the price which should be selected.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, spoke of the 3-cent fare case of that company, in which the elements of the value of the property and the return on the investment were vital. The State Tax Commission valued the Milwaukee property at 70 per cent of the total capitalization. Mr. Duffy does not favor the application of a regular sinking fund, which is a percentage of the investment. The Milwaukee Electric Railway & Light Company sets aside 10 per cent of its gross earnings to provide for depreciation. This example had been followed by other companies with which Mr. Beggs has been connected. The amount is set aside to cover depreciation, but not ordinary maintenance expenses. Maintenance expenses include renewals of worn parts, up-keep and regular repairs. The depreciation reserve is used to pay extraordinary repairs or reconstruction. A figure of 10 per cent of the gross earnings was chosen because this was all that could be set aside and give the investors a reasonable return on their investment.

Mr. Duffy said that in the street-railway business 10 per cent of the gross earnings is not half enough for depreciation. He thought that 20 per cent would not cover it. In a further discussion of depreciation he expressed the opinion that the Wisconsin Public Service Commission has done more than any other one force to improve the standing of electrical securities in Wisconsin. One result of the work of the commission has been to force companies onto a more solid financial basis.

In Milwaukee the same percentage of the gross earnings in the lighting department is set aside for depreciation as in the railway department.

Mr. Duffy said, in answer to a question, that depreciation based on a percentage of the gross earnings is in some ways more logical than depreciation based on a percentage of the value of the property, because depreciation and wear are to a large extent dependent on the amount of wear which the property gets, and this in turn is somewhat proportional to the gross earnings.

Mr. Almert raised the question whether the money spent in new-business promotion, in bringing a central-station property up to a good paying basis in a short time, could be charged against its cost. He took for example two plants, one of which was built and allowed to run along for several years without much effort to get business, until finally the earnings were sufficient to bring a good return on the investment. In the case of the other plant a certain amount of money was immediately invested in new-business promotion, bringing the plant up to a good paying basis in a very short time as compared with that in the case of the other. The question was asked whether it would be justifiable to charge this new-business investment against property account. The point is one in which many companies developing property are vitally interested. Mr. McGovern said that his company added from 10 per cent to 15 per cent to the physical value of the property to obtain the going value.

Again, on the subject of depreciation, Mr. Duffy said that in 1899 the Detroit street-railway property was valued at $14,000,000 by three experts of high personal and technical standing employed by the city. Recently, 10 years later, the same railway had been revalued for franchise purposes by another commission made up of men of high standing and broad experience. These placed the value at $12,000,000. During those 10

years $6,000,000 cash had been put into the property in addition to its previous valuation of $14,000,000. Thus $8,000,000 out of a value of $20,000,000 had disappeared in depreciation.

Mr. T. C. Martin, executive secretary of the National Electric Light Association, said that his association had considered the question of depreciation, but thought that the matter should be taken up in conjunction with organizations representing parallel lines of public utility, such as railways, water, gas and power transmission companies. The electric light association has, therefore, joined hands with associations representing the other interests and in the course of time it hopes to have some results to report.

Prof. C. M. Jansky, of the University of Wisconsin, in summing up the discussion, made the two points that at present depreciation is defined in a variety of ways and that the amount of depreciation which should be set aside is not yet sufficiently known. Mr. W. H. Winslow, of Superior, Wis., explained that his company charges to depreciation 16.33 per cent of the gross electrical revenue.

COOKING AND HEATING BY ELECTRICITY.

Mr. W. B. Voth, general superintendent of the Sheboygan Light, Power & Railway Company, gave an interesting paper at the Wisconsin Electrical Association convention in Milwaukee, Jan. 19 and 20.

Mr. Voth's object in presenting this paper was to discuss methods by which central stations would be most benefited, whether by pushing complete cooking and baking outfits on separate meters at rates lower than those for lighting, or by pushing the use of a few utensils, as the flatiron, at a time. He pointed out that electric heat is not cheap to produce, but may be economical because of efficiency in its use. The electric flatiron is a good example of this, when the cost of ironing a certain amount is taken as a measure of economy. The day of electrical household cooking is fast approaching, he predicted. Durability has been fairly reached in such utensils, although slowness of heating and wastefulness of energy are objections still found in a few devices.

In the frying pan and tea kettle, the apparatus with the self-contained heating element is too heavy, clumsy and hard to clean, he thought. Utensils that set on a disk or flat heating element would be better. The ideal electric cooking cabinet would consist of a fixture using some material like tile or cement, for the table and back, so that spattered grease could be cleaned or easily removed.

To determine the cost of operation of the utensils and also to find to what extent the current demand would affect the lighting regulation during the December peak, the author of the paper installed in his household a complete kitchen outfit and made a trial of each individual article. Mr. Voth's residence was located on the secondary lines, about 1½ blocks from a 10-kw transformer. This same transformer supplied a small factory, a dock, a warehouse, three stores, two offices and eight small residences. A 20-amp watt-hour meter was installed at the kitchen cabinet, and was read after each meal, or, when possible, after each utensil was used. The outfit consisted of one oven, one 7-in. frying pan, one grid, one broiler, one percolator, 1-pt. water heater, one 2-qt. combination cooker, one toaster and one flatiron. As regards cooking, the oven was very successful, especially with meat, which seemed to come out unusually tender, due possibly to the regular and steady heat. However, the oven proved almost too expensive to operate and also caused a drop of about 6 volts on the service line when on highest heat. The frying pans were found heavy and hard to handle, especially in trying to pour out the contents. They also made extra work in cleaning. The 7-in. frying pan was more efficient than the larger 10-in. pan. The amount of bacon that filled the 10-in. pan was fried with less energy in the 7-in. by filling it twice. If the electric frying pan could be made to be lighter and more easily cleaned, it should become a useful and very efficient utensil. The broiler for steaks and meats required 12 minutes to reach its highest temperature. The electric broiler has the advantage over the gas or coal broiler in that the greases are saved and that the cook is not subject to the intense heat of the stove. The high current demand is an objection for evening use.

The coffee percolator, although a very pretty ornament, Mr. Voth thought too slow for the salaried man who must be on deck when the whistle blows, while it is an added burden for the busy housewife to wash and keep clean. The hot-water heater is one of the most useful quick-lunch devices on the list in the 1-pt. to 4-pt. sizes. With it very good coffee is made in a short time; just as good as in the percolator. It should, however, have a lip similar to the household coffee pot, so it can be used on the dining-room table. When this lip is added a strainer, such as is usually employed, can also be attached. In placing such a device among customers for coffee-making, printed directions explaining how to make good coffee should be distributed. It is then possible to make the same quality of coffee each time by simply letting the required amount of water come to a boil, putting in the coffee, leaving the current turned on for a certain time and then disconnecting. The hot-water heater can also be employed for boiling eggs, etc., but it would be more practical to try to sell two heaters, one for coffee purposes and the other for miscellaneous uses.

The combination cereal cooker, or double boiler, was used in the experiment for cooking oatmeal, rolled wheat, cracked wheat, farina and malted wheat. The device cooked all of them successfully, and it was necessary to leave the current on only 20 minutes—10 minutes at the high heat and five minutes at the low heat. With the exception of cracked wheat, all these cereals can be cooked at the breakfast table if desired. A cereal like oatmeal, however, should not be served within 15 minutes to 20 minutes. With such a cereal the heat should be left on at the high temperature until the water comes to a boil, which is in about 10 minutes. It should then be left on the low heat for five minutes or 10 minutes more. The current may now be turned off, and the cereal continues cooking from the retained heat in the elements and water jacket. Oatmeal was hot for an hour and a half after current had been turned off. Any cereal was cooked with a consumption of about 200 watt-hours. The double cooker is easily kept clean, as the cereal is in part separate from the heating element, and being water-jacketed the food will not bake fast on the container. The cereal can be put into the cooker the night before and left on long enough to get hot, then turned off and in the morning again turned on and when hot it is ready to serve. Cooking in this manner makes a decided improvement in the quality, and costs only a little more than if continued at one time. A cereal can be cooked at a consumption of from 250 watt-hours to 300 watt-hours in this manner. When the cereal is fully cooked the inner dish may be removed and the water used to boil eggs or potatoes.

The toaster, like the flatiron, needs no introduction as a successful and economical utensil. It is only necessary to devise ways and means to show customers its advantages. Putting toasters out on trial is recommended.

The success of the flatiron is well known. The writer made a few experiments with the flatiron inverted and used as a stove or hot disk. Oatmeal and cereals were thus cooked in a dish on a 6-lb. flatiron, although it required a little more time and also a little more current to cook the cereals on the flatiron than in the cereal cooker. The iron held the heat for 30 minutes after current was turned off, thus allowing slow boiling, but would be too slow for breakfast use.

Mr. Voth concludes from the average of a large number of experiments made under varying conditions, that if the cost of electricity per kw-hour is more than the cost of 18 cu. ft. of gas the latter will be the cheaper heating agent, otherwise electric heating is the more economical. This means that with gas at $1 per 1000 cu. ft. electricity must sell for about 2 cents per kw-hour. However, it would not be necessary to sell electricity at this low rate to establish successful competition, as the many conveniences and advantages of electric heating devices would enable central stations to get at least 3 cents or more per kw-hour and still give gas a hard rub.

Although the hopes for the past year for a successful fireless

cooker were not realized, such a device would be very welcome on account of the low maximum-current demand. For the immediate future the work of pushing heating and cooking devices is for the central station, rather than for the contractor and department store. After cooking devices are better known, the work can be turned over to others.

It has been stated that the average consumption of a family of four for electric cooking purposes is 84 kw-hours per month, which seems a little low. Since the capacity demanded by a cooking outfit is greater or equal to that of several residence consumers, it is not desirable that the complete apparatus be operated during the lighting peak. The peak of the electric kitchen recedes a little before the factory peak recedes. The cooking peaks in the winter months will affect the lighting regulation in the morning, but not to such an extent as in the evening, as not so many utensils are called into use for the early meal.

Mr. Voth favored the introduction of one device at a time into every home, following this up with another device which has been found reliable, durable and economical. An increase of 50 cents per month per residence consumer will result in a good increase in gross revenue. Too little attention is paid to the residence load. For every 10 stores or factories there are usually 50 to 100 residences.

The writer gave results of a test in a bedroom in which a 2000-watt air-heater was installed. This was an outside room, which was not affected by the heating of the rest of the house. It has an east and north exposure, and measured 14 ft. x 13 ft., with about 1600 cu. ft. contents. Readings taken daily for about a month showed that to keep the temperature between 50 deg. Fahr. and 60 deg. Fahr. requires from 8 kw-hours to 29 kw-hours per 24 hours, the outside temperature varying from 44 deg. above zero to about 5 deg. below zero. To compete with a hard-coal heater the current would have to be sold for 1 cent per kw-hour. Of course, the matter of convenience would be in the electric heater's favor. In the tests mentioned the average number of kw-hours used per day was 18.3, the average inside temperature 54 deg. Fahr., and the average outside temperature 18.2 deg. Fahr.

The electric heater used in a small room, such as a bathroom or a bedroom, is not expensive, as the time of service is not long and it is a great convenience. It will be used mainly at times of the year when it is not advisable to have a furnace or heater going.

The electric heated appliances and machinery in use for commercial purposes reach a much higher figure than is generally supposed. The conditions at the present time are ripe for the central station to develop this class of business. The field is a wide one, covering a variety of applications in which steam, gas or other agents are now in use. In a tinsmith shop where soldering is continuous a soldering iron brings the central station an average income of $2.50 per month through the lighting meter. Special electric tools are used in the leather industry. Glue pots are also very successful and economical, and can find use in many trades.

Commercial electric heating will be largely associated with the requirements for power. In many instances power cannot be obtained by the central station unless the heating is supplied also. Both can be operated from the same service lines and meters.

During the discussion which followed, Mr. J. R. Cravath, of Chicago, said that from 0.30 kw-hour to 0.33 kw-hour per meal per person was a fair average figure for all cooking. This did not include hot-water heating for other than cooking purposes. Mr. P. H. Korst, of Janesville, spoke of the "Caloric" fireless cooker which is being made in his city. Experiments are being carried on to adapt this to electric heating. Mr. Korst made an experiment with electric heating in his own family several years ago. His experience was that with electricity at 4 cents per kw-hour the cost for all cooking was double what it would have been with gas at $1 per 1000 cu. ft.

Mr. Ernest Gonzenbach, of Sheboygan, complained of the high first cost charged for electric cooking utensils. Mr. L. L. Tessier, of Depere, reported having 195 flatirons out on his lines, 75 of which were placed last season. He also has 12 to 15 toasters.

Mr. H. C. Stirling, of New London, Wis., showed a small electric fireless cooker with which he is experimenting. This has an oven 10 in. x 10 in. inside, and contains a 350-watt heating element. With a 500-watt element in this size of oven 15 minutes is required to bring the oven up to 350 deg. Fahr., which is sufficient for baking. The device has a thermostat which opens the circuit when a certain desired temperature is reached, closing a circuit through a solenoid which opens the main switch. In his experiments a 12-in. x 16-in. oven with an 800-watt heating element took 25 minutes to bring up to baking temperature. Mr. Stirling intends to use a fusible plug in his next oven, which will melt out and cut off the current in case of emergency should the thermostat fail to work. This overcomes the fire risk complained of by the underwriters.

Mr. Winslow, of Superior, said that it seemed to him the only way to get the electric heating business is by means of heat storage. He mentioned the "Therol" system of heat storage in a block of lagged cast iron, which was brought out in England and is now being introduced in this country. He thought this principle might also be adapted to baking. In order to make this electric cooking business feasible it ought to be possible to do all the electric cooking work of a residence on a maximum demand of 600 watts.

Mr. H. G. D. Nutting, of Fort Atkinson, said that he had also been experimenting with a fireless cooker, using the safety fuse plug mentioned by Mr. Stirling. He thinks the whole apparatus can be made automatic. He uses a time switch in connection with the device, which can be set to throw on current a little while before rising time in the morning.

HANDLING COMPLAINTS AND ENFORCING DISCOUNT DATES.

At the meeting of the Wisconsin Electrical Association held at Milwaukee, Jan. 19 and 20, Mr. W. R. Putnam, of Marinette and Menominee, read a paper on the subject of handling complaints and enforcing discount dates. He said that complaints could be divided into two classes: those due to reasonable causes and the unreasonable complaints. These should be handled with the primary object of satisfying the complainant, and, secondarily, for the purpose of discovering improvements which should be made in service.

Some customers, feeling that they have a just cause, are sincere in their complaints. There are others who complain on the general principle that it will do no harm and may do some good. The feeling is too often prevalent in the public-utility office that the burden of proof as to a complaint should lie with the consumer. On the other hand, the way to handle the customer properly is either to locate and correct the fault or to demonstrate that none exists.

Proper investigation shows that a large percentage of customers who change to some other form of service are lost because of some real or fancied fault on the part of the company, which has not been remedied or even attended to. It is easier to retain such a customer than to get a new one to take his place. A disgruntled customer, though still using service, does more damage to new-business prospects than can be overcome by weeks of work.

When a company's office force consists of more than one man, the cashier or clerk who receives the money should not attempt to settle a complaint. The cashier has not the time, and complaints are made at the very time when he is busy taking care of customers paying bills. If he does take the time he provokes the waiting customer who becomes impatient and also enters a complaint. In the mind of the customer the cashier is the physical embodiment of the worst feature of the soulless corporation, namely, its grasping for money.

The complaint clerk should necessarily be able to give all of his time to following up a complaint until it is properly disposed of. Complaints should be turned over to this complaint clerk at once by the cashier or individual waiting on them. It should be this complaint clerk's first duty to see that the matter is investigated and, if possible, the complainant satisfied. When

poor service is complained of there should be entered on a card properly arranged for this purpose the nature of the complaint and all details in reference thereto. The clerk should be familiar with conditions causing a variation in voltage on different parts of the system. He can then instantly determine whether the condition complained of is local or general. In case of general trouble, which probably is due to some exceptional operating difficulty, he must explain it to the customer's satisfaction and show how the company is doing its best to overcome the trouble. As a rule, thorough explanations of this nature will satisfy the customer. A monthly record of general complaints is of great assistance to the manager in determining the necessity for improvements in the operating department.

Local complaints, as a rule, will far outnumber the general complaints. Their causes will be so varied that often considerable time must be spent on them. A recording portable voltmeter is of the utmost necessity in determining the exact voltage.

Complaints about high bills, as a rule, are more troublesome to handle than poor-service complaints. By entering the consumer's bill on a card for the past two years, the complaint clerk can tell at a glance whether the complaint has any foundation. From one-third to one-half of these complaints are settled at once by showing such a statement to the customer. A large number of customers make complaints without making such comparisons. If the bills are above normal for that customer, the next move for the complaint clerk is to secure from the customer a statement, necessarily approximate, as to the number of lights and the hours burned each day, and from this determine the consumption and the bill. In case this does not satisfy the customer a recording wattmeter will show where the current is being used and at the same time furnish a check on the regular meter. When the cause of the complaint has been corrected it should be the rule that the maker of the complaint be seen and that he be satisfied. If possible secure a letter from him commenting on the improvement in service, as such letters may be of great assistance.

After a complaint department is well organized, complaints should be solicited through the newspapers and by other forms of advertising. The complaint department should not stop here, but in connection with the new-business department should arrange for periodical visits to all customers to learn whether they are satisfied with the service. Such visits should be made four times a year if possible. Enough orders for supplies and appliances will be secured through these visits to pay for their entire cost. Many appliances are laid aside by customers after being used a short time, because they do not work properly or because of their large consumption of electricity. The company would never know of these except through visits from complaint solicitors. Most of these appliances could be put into service again at no cost to the company.

In the enforcing of discount payments there is only one satisfactory rule, which is to allow no discounts after the discount day. Occasionally a condition arises where it seems a good policy not to make the customer pay this discount out of his own pocket. Never allow the cashier to make such allowances, but have them handled by the complaint department or manager. Explain to him that it is impossible to pass the amount, but that since you do not want him to pay it out of his own pocket you are willing to do so yourself this once, on condition that he will never ask for a discount again after discount day. Then pay him the amount of the difference out of your pocket and make him pay the cashier the bill in full.

Any company about to establish a discount day should be very careful to impress on the customers that the discount is a premium offered for prompt payment, and that it is not a penalty added nor an interest charged on the full payment.

In taking up the discussion of Mr. Putnam's paper, Mr. H. Almert, of Chicago, expressed the decided opinion that the term "complaint department" is a mistake. He prefers the use of the term "information department."

One of the first things a company frequently does in fitting up an elaborate office is to establish a cashier's window and next to it a "complaint" window. Mr. Almert thought the complaint window should be located as far as possible from the cashier's desk. People who come in to pay bills and hear the reiteration of complaints at the complaint window are apt to think that they have something to kick about themselves and had better register it on general principles. In other words, it puts ideas into satisfied customers' heads which otherwise never would be there. One large company makes it a point to have a gentleman near the door who sees that no one ever leaves the company's offices except in a good frame of mind. He is ostensibly an appliance salesman, and has his desk near the door. If he sees anyone leaving the office in a disgruntled state of mind, he makes it a point to intercept him in some way and after some friendly talk learns the trouble and frequently puts the complainant in an entirely different frame of mind.

He recommended that a recording voltmeter connected to the company's lines be kept in the new-business department. This is for the information of the new-business department and also as a check on the operating department. The new-business department will be able by the aid of this information to tell whether there have been abnormal cases of low voltage.

One company has met with success by combining for one man the work of looking after meter complaints and the illuminating engineering on customers' premises. In a great many cases complaints as to high bills and fast meters are really due to bad illuminating engineering, and the ineffective use of light by the customer. When the man goes to test the meter he can also look over the lighting installation and find out whether light is being wasted unnecessarily. Frequently he can get the customer to install proper lamps and glassware and turn him into a satisfied customer without any reduction of his bill.

Mr. W. H. Winslow, of Superior, explained that he allows consumers to 10 a. m. of the day following discount day to pay up. This also allows for checks mailed the day before.

Mr. Almert said that discount for prompt payment, if very large, is sure to make trouble. If a consumer loses a large discount for failure to pay promptly, it makes him much dissatisfied. Furthermore, there is no equity in such large discounts.

In one company the secretary makes it a point to call up each delinquent the day before the discount expires. This company is owned by a New York syndicate and reports have to be made each month as to the delinquents on the expiration of the discount period. The secretary explains that this report has to be made and that he does not want the consumer in question to be reported as delinquent. He makes the consumer feel that he is doing a personal favor in notifying him of his delinquency. In some cases if the consumer is out of town, he takes it upon himself to pay the bill for the consumer and call it to his attention as soon as he returns. All of this, of course, creates good feeling.

Mr. H. A. Miles, of Durand, said that he makes it a point to treat each complaining consumer as if there were six other lighting companies in the town ready to do business in case the consumer was dissatisfied. By following this policy, which is used by merchants in other lines, the number of his consumers has been increased 44 per cent in the last 14 months.

Mr. George B. Wheeler, of Eau Claire, questioned whether a cash discount is advisable or justifiable. The customers whose credit is the best are the ones who usually take most advantage of the discount, whereas those who are poor pay let it go anyway, so that the company is not really ahead on the game.

Mr. Almert, in reply, thought that a discount is very important. He cited the case of one company where the custom was to make a discount on the lighting bill for prompt payment, but not on the power bill. The result was that four-fifths of the collector's time was devoted to collecting the power bills and only one-fifth devoted to the residence and commercial lighting which had the discount for prompt payment. In this case the cost of collecting bills was from 5 per cent to 7.5 per cent of the total amount collected by the collector.

Mr. F. W. Downs, of Washburn, Wis., reported a very small loss from uncollected bills, even though no discount is given.

Mr. P. A. Pamperin did not favor the application of a dis-

count for prompt payment in small towns where the manager is acquainted with every consumer. In such cases consumers are apt to look unfavorably on such a plan.

Mr. M. C. Ewing, of Wausau, said that formerly his company had a meter rental charge of 25 cents per month. Now this meter rental is given to the consumer as a discount in case of prompt payment. In other words, there is a penalty of 25 cents per month for failure to pay within the specified time. This, however, is called a discount rather than a penalty. Thus discounting the meter rental charge proved a very popular move.

Mr. P. H. Korst, of Janesville, objected to calling such an arrangement a penalty. He thought that the matter of allowing a cash discount for prompt payment should depend very much upon the size of the town. In large towns it is advisable, but perhaps not in small towns.

The discussion then drifted into the question of minimum bills, meter rentals and service charges. Mr. George B. Wheeler, of Eau Claire, said he could not figure the cost below 75 cents per consumer per month, as a fixed or minimum charge. He could not see how the 25 cents per month charged by some companies as a meter rental would cover the expense. He thought that companies should agree on some equitable minimum charge in order to appear in a consistent light before the State commission.

Mr. Pamperin brought out the interesting point that a fixed or service charge of 25 cents per month, to which is added the regular kw-hour charge, will in practice yield the company as much gross revenue as a minimum bill of $1 and no fixed service charge. He had added up the revenue which would be obtained from 80 of his smallest consumers during the three summer months at 7 cents per kw-hour and found that all of the consumers fell under the $1 minimum charge, averaging 69 cents per month each. Now if there was a fixed-service charge of 25 cents per month for consumers the central station would obtain 94 cents per consumer from these smallest services. This would be almost as much as if he had charged these small consumers a $1 minimum bill. If all the consumers on the system are taken into account, however, the gross earnings would be greater with the 25-cent fixed-service or meter charge.

Mr. Ewing, of Wausau, said that he did not defend such a low meter or minimum charge as his company formerly had before it gave the 25-cent reduction for prompt payment. They now call this 25 cents a collection charge in Wausau.

Mr. Almert advised the company having a $1 minimum charge to "hang onto it." He could not see where less than $1 should be made to cover service charges. The cost of maintaining service in the average residence he figures as from $1.30 to $1.70.

Mr. Miles, of Durand, makes a minimum charge of 75 cents. Some consumers have as low as two lamps, but are satisfied with this minimum charge.

Mr. W. H. Winslow, of Superior, said that he had made an analysis of this subject for a certain period and found that with gross earnings of $108,000 the company would have lost $1,218 had not the minimum bill of $1 been enforced. In other words, this $1,218 was the difference between the actual consumption of the consumers falling below the $1 minimum and the $1 charge.

Mr. P. H. Korst said, in regard to the attitude of the public service commission on minimum bills and service charges, that the commission had authorized, in a number of cases, a readiness-to-serve charge which amounts to much more than a $1 minimum bill. He thought that the minimum bill of $1 hurts the growth of the business in some cases. A number of small consumers in his town objected to paying $1 per month without regard to the amount they used under $1. However, the electric iron had come in very nicely, he said, to overcome this objection. People soon appreciated the fact that they could use the iron a part of the time for nothing, because this would come below the minimum bill. As a matter of fact, the consumption frequently ran over the $1 minimum, but the consumer would not object to this, because he would think that he was getting a part of the energy for his electric ironing for nothing.

Mr. W. H. Winslow, of Superior, told of an analysis he had made of his consumers' accounts to determine what should be charged as a fixed readiness-to-serve rate and what should be the kw-hour rate. The figure he determined was a fixed charge of 15 cents per month per 50 watts of maximum demand, plus 4 cents per kw-hour. For residences the maximum demand upon which the fixed charge is made is taken as 100 per cent for the first 250 watts; 33.3 per cent for the second 250 watts, and 16.66 per cent for all over 500 watts connected. In stores the first 500 watts is figured at 100 per cent, the second 500 watts at 80 per cent, and all over that at 60 per cent.

Wiring and Illumination

SPECIAL STREET LIGHTING IN ROSELAND, CHICAGO.

The latest addition to the neighborhoods in Chicago adopting special street illumination to attract business in the interest of local merchants is Roseland, a locality in the extreme southern part of the city. Here the merchants have installed 42 street-lighting posts, each post supporting four 60-watt tungsten lamps. The posts are painted white instead of the "conventional black." The Commonwealth Edison Company supplies the electricity for this street lighting and also maintains the service.

WIRING HOUSES AT COST IN CHICAGO.

The Commonwealth Edison Company, of Chicago, in 1907 conceived the idea of inducing the owners of unwired houses and apartments to have their premises wired by doing the wiring and fixture work at cost and spreading the payments over a period of two years without interest. The company has wired over 1100 houses on this plan and has just issued a booklet illustrating a few of the dwellings it has wired with particulars as to the number of lamps, switches, average cost, etc. A few of the letters received commending the workmen and expressing satisfaction with the method of payment and the neatness and dispatch with which the work was accomplished are also included.

Reproduction of Cover of Commonwealth Edison Booklet.

The company had to combat the usual impression which prevails, that the wiring of old houses necessitates considerable additional expense for new decorations where the wires are concealed beneath the plaster and lath. This impression in most cases was dispelled by explanations by the company's experts, and after being assured that it would not be necessary to redecorate, owners and tenants were anxious to have the work started.

CHARACTERISTICS OF CARBON AND METALLIC-FILAMENT LAMPS.

A recent issue of the *Minnesota Engineer*, published at the University of Minnesota, contains an article by Mr. A. J. Hitzker giving some interesting data relating to the characteristics of carbon and metallic filament lamps.

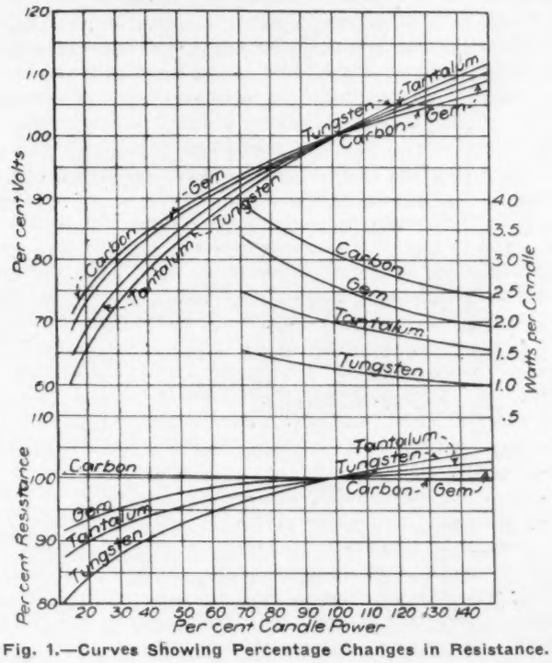


Fig. 1.—Curves Showing Percentage Changes in Resistance.

The accompanying table shows the resistances of the several types of filaments when at room temperature and when in

Type of Lamp.	Rating, Watts.	Resistance in Ohms— Cold.	Hot.
Carbon, 19 cp.	59	430	214
Carbon, 38 cp.	118	222	105
Tantalum	40	60	315
Tantalum	80	30	160
Tungsten	25	35	450
Tungsten	40	30	353
Tungsten	60	23	215
Tungsten	100	12	130
Tungsten	250	5	54

active service; these lamps are for electromotive forces of from 100 volts to 120 volts. It will be noted that the resistance of a carbon filament decreases by 50 per cent, that of a tantalum increases by 400 per cent and that of a tungsten increases by 1600 per cent when heated from room temperature to the operating temperature.

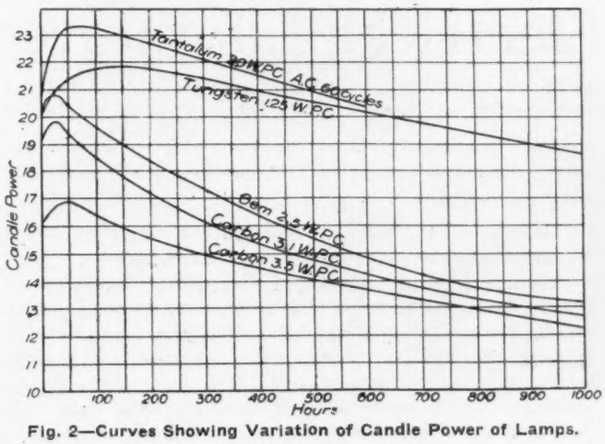


Fig. 2—Curves Showing Variation of Candle Power of Lamps.

In Fig. 1 are shown the percentage changes in resistance as the candle-power is varied from 20 per cent to 150 per cent of normal. The specific consumptions of the several filaments are shown for changes in candle-power from 70 per cent to 150 per cent of normal, while an indication of the changes that must be made in the electromotive force impressed upon each filament, in order to produce the variations indicated, is also given in Fig. 1.

In Fig. 2 are given curves showing the variation in candle-power of carbon tungsten and tantalum lamps throughout their life up to 1000 hours. The curves relate to a 16-cp carbon lamp consuming 3.5 watts per candle, a 19-cp carbon lamp consuming 3.1 watts, a 20-cp graphitized-carbon lamp consuming 2.5 watts, a 20-cp tantalum lamp consuming 2 watts, and a tungsten lamp consuming 1.25 watts per candle. It will be noted that throughout its whole life of 600 hours at a frequency of 60 cycles, the tantalum lamp operated at a candle-power above its initial rated value. The tungsten lamp maintained its initial candle-power for 650 hours, and even at 1000 hours it gave 94 per cent of its rated output. The greatest decrease in candle-power was shown by the Gem graphitized carbon-filament lamp, which maintained its initial candle-power for only 75 hours, and at the end of 1000 hours gave only 66 per cent of its rated candle-power.

ILLUMINATION OF EXCHANGE PLACE, PROVIDENCE, R. I.

When flaming arcs were installed in Copley Square, Boston, wide publicity was given the event, and Copley Square was

Fig. 1—Illumination of Exchange Place by Enclosed Arcs.

claimed to be the best example of public lighting in America. Certain public-spirited citizens of Providence heard of Boston's triumph and immediately inquired of the Narragansett Electric Light Company what it could do to make Providence as famous.

Exchange Place is the principal public square of Providence. It is separated from the railroad station on one side by a park, while at either end stand the municipal and Government buildings. The other side of the square is devoted to business buildings. Up to a few months ago this area was lighted with 36 open arcs rated at 10 amp, 40 volts, for which the company received $100 per lamp a year. The lamps were suspended 19 ft. above the curb.

At the time the question of new lamps was under consideration there was a strong sentiment in favor of flaming arcs, but the company was able to procure two magnetite lamps rated

Fig. 2—Illumination of Exchange Place by Magnetite Arc Lamps.

at 10 amp, 80 volts, and these were installed for testing purposes. The lamps were examined by the Council committee, which also went to Boston to inspect the illumination of Copley

Square. The committee reported favorably on the magnetite lamps, and a five-year contract was made with the Narragansett company.

Under the new contract the company has removed the 36 open arcs and installed 27 magnetite lamps on 31-ft. poles of the ordinary bishop's crook variety. The new lamps increase the total energy consumption about 60 per cent, but give four times the illumination, while the total additional cost is $841.50, the charge for the new lamps being identical with the cost of the Copley Square lamps—$164.50.

Tests made by the company show that the average distance at which a newspaper could be read with light from the old lamps was 60 ft., with the magnetite lamps the distance is 245 ft. Under the contract the lighting company reserves the right to change the type of lamp at any time, subject to the approval and consent of the city lighting committee.

Letters to the Editor.

Coal Consumption in High-Speed Engine Stations.

To the Editor of Electrical World:

Sir:—As there is a great number of high-speed stations in operation, comparisons along the line outlined in the article, "Coal Consumption in High-Speed Engine Stations," which appeared in the December number, would be beneficial to many. The Edison Electric Illuminating Company's station at West Chester, Pa., is operating one 400-hp, high-speed Corliss engine for peak load; one 300-hp, single-valve, tandem-compound, high-speed engine for all-night service, and a 200-hp, single-valve, simple high-speed unit for day service. A heating system requiring more or less live steam during eight months of the year is installed in connection with the system and during the four summer months of 1909 with the shortest peak and poorest load factor generally of any time of the year, the station showed a coal consumption of 6.55 lb. per kw-hour output. The railroad weights were accepted for nearly the entire coal supply during these months. As compared with the results obtained at Hobart, Okla., and Montrose, Col., these figures should be of interest.

West Chester, Pa. James E. Pyle.

High-Frequency Alternator.

To the Editor of Electrical World:

Sir:—The note on the Alexanderson high-frequency alternators in the first issue of the *Electrical World* for December, 1909, has just come to my notice, and I think it might be well at the present time to call the attention of those engaged in this field to a principle which has appeared in electrical literature from time to time, which states that the frequency of the current generated by an alternator the field of which is excited by an alternating current is equal to the frequency of the exciting current plus the frequency of the current which the alternator would generate if excited by direct current. To have this principle hold good, however, it is necessary to use polyphase currents for exciting the field of the alternator, which must be wound so as to produce a rotating magnetism.

The above phenomenon is usually demonstrated by means of a complicated mathematical treatment, but the following explanation will probably be more to the point to those who are not familiar with mathematical reasoning. If the field circuit of an alternator be connected to a source of alternating current, there will be produced a magnetic field which rotates at the same electrical speed as the frequency of the exciting current—that is, through 360 electrical degrees in one cycle—and if the field structure be mechanically rotated, this motion will be added to that of the already rotating magnetic field, giving it a final value equal to the sum of the two speeds. It is evident, therefore, that an armature placed in this rotating field will generate a current having a frequency equal to the electrical speed of the rotating magnetic field. This principle is not limited to two machines, but may be applied to as many machines as may prove desirable. For this purpose two-phase currents would be the most useful, and since a two-phase machine requires twice as many slots in the armature as a single-phase, and since the available space for slots in the Alexanderson single-phase, 100,000-cycle machine is at present fully occupied, it follows that to change the machine from single-phase to two-phase would cut the frequency down one-half. As this change would make it necessary to use twice as many generators to attain a given frequency, it is easily seen that it is very undesirable. The difficulty can be overcome by substituting for the armature at present used two armatures of the same diameter, but only half the length, spaced 90 electrical degrees apart. With this arrangement the machine will generate two-phase current and still have the same frequency.

Now consider the 100,000-cycle machines mentioned in the above note. If the field of one machine "B" is excited by current from another similar machine "A," the current generated will have a frequency of 200,000 cycles per second. If this current be used to excite the field of a similar machine "C," the current generated by this machine will not have a frequency of 400,000 cycles, as was at first believed, but 300,000 cycles per second. By using 10 of these machines a frequency of 1,000,000 cycles would be produced. It should be borne in mind that the first machines of such a series would merely have to handle the exciting current for the next one in the series and would need be of only comparatively small size.

White River Junction, Vt. Harold W. Bourlet.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Voltage Drop in Transformers.—J. A. Schouten.—The author gives a simple diagram which permits one to read off directly for any current and phase difference the voltage drop in a transformer. The curves of equal voltage drop are straight lines.—*Elek. Zeit.*, Jan. 13.

Mercury Rectifier.—Schulze.—Mercury rectifiers are based on the principle that they permit the current to pass practically only in one direction. As a matter of fact, a small current passes in the other direction, although it is so small as to be of no practical importance. The author has investigated the mean value of this return current and its wave form for a number of different mercury rectifiers. The return current increases only slightly with increasing voltage of the rectified current, but increases greatly with the amperes of the rectified current. Further, the return current is greater for a storage-battery load than for an incandescent lamp load.—*Elek. Zeit.*, Jan. 13.

Hunting.—W. W. Firth.—The speed of a series motor when supplied with energy at constant pressure changes very greatly with change of load, and becomes excessive at light loads. If, however, the motor is driven from a series generator of suitable design the speed will be absolutely constant, as shown by Kapp. During some tests on such a constant-speed arrangement, remarkable hunting was found to occur when the line resistance was reduced below a certain critical limit. The author studied experimentally these phenomena of hunting and gives an explanation on the basis of the difference in the residual magnetism of the two machines.—Lond. *Electrician*, Dec. 31.

Potential Transformers.—M. G. LLOYD AND P. G. AGNEW.—The formulas now in general use for calculating the regulation (the change of secondary voltage with load) of potential transformers involves the magnetizing current. The authors show, however, both theoretically and experimentally, that the magnetizing current has practically no effect on the regulation in spite of statements to the contrary.—*Bull. Bureau of Standards*, Vol. 6, No. 2, November, 1909.

Multiple-Speed Induction Motors.—HENRY.—The first part of an illustrated serial on induction motors for adjustable speed. In the present installment the author deals especially with methods based on a variation of the number of poles.—*L'Industrie Elec.*, Jan. 10.

Lamps and Lighting.

Flame-Arc Lamp.—W. WEDDING.—The author emphasizes the difficulties which have been experienced with the mechanism of

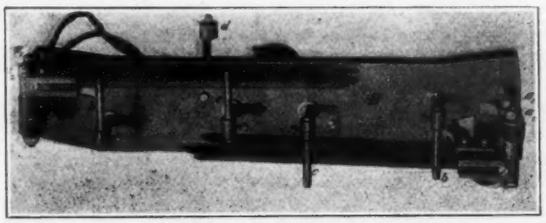


Fig. 1.—View of Four Electrodes.

arc lamps by the introduction of impregnated carbons electroded. A great simplification has already been obtained in the Beck lamp, and further progress in simplifying the regulating mechanism has been made in the Timar-Dreger flame-arc lamp, which is described in detail in the present article. The lamp has four electrodes arranged in two pairs, and all placed horizontally and parallel. A view of the four electrodes looking from below upward is given in Fig. 1. The upper electrode of each pair is positive and the lower negative. When there is no current flowing the end of each positive electrode

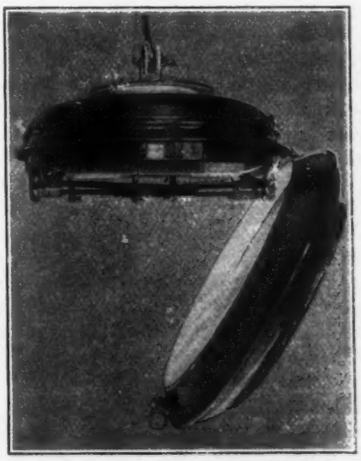


Fig. 2—Lamp Open.

rests on the corresponding lower negative electrode. When the circuit is closed a magnetic device raises the two positive electrodes and brings them into a position parallel to the negative electrodes. To get a good distribution of light the upper positive electrode is made somewhat longer than the lower negative electrode. The cast-iron plate *B* in Fig. 1 serves at the same time as a reflector. Fig. 2 shows the completed lamp opened. The lamp is said to have worked very satisfactorily in a trial of several months. With a lamp having a normal current of 10 amp the current could be decreased to 3 amp without disturbing the lamp. But at 3 amp the light of the lamp became restless and one of the arcs was extinguished, since the strength of the magnetic device cannot hold both of the positive electrodes upward. One will therefore drop and make direct contact with the negative electrode. The other will, however, continue to burn, since it is now supplied with a stronger current. The ordinary electrodes for flame-arc lamps are used, but an oval cross-section instead of a circular one is employed. The specific consumption is about 0.215 watt per mean lower hemispherical hefner candle-power for a lamp without globe. Since the lamp is very simple in construction, it is thought that serious disturbances are hardly likely.—*Elek. Zeit.*, Jan. 13.

Flame-Arc Lamp.—A fully illustrated description of the Foster multiple-electrode flame-arc lamp which has recently been placed on the market in England. The electrodes of this lamp consist of from two to four cored carbons molded together, and the arc burns from one pair at a time, changing electrodes as they are burned down. Striking and feeding are effected by a brake mechanism without any clockwork. Neither electrode is swung for striking, because, owing to the wide angle at which the electrodes are placed, a simple lift of the brake mechanism suffices. With a four-carbon electrode, 24 in. long, from 40 to 50 burning hours are obtained.—Lond. *Elec. Eng'ing*, Jan. 6.

Low-Frequency Arc Lighting.—According to a statement of the Allg. Elek. Ges., the auxiliary lighting of the Dammtor station at Hamburg is carried out by four flame-arc lamps working on a circuit whose frequency is 25. These lamps burn in groups, two being connected in series across a pressure of 110 volts. The alternating current, by which they are supplied, is taken directly from the tramway feeder belonging to the Blankenese-Ohlsdorf Railway, the e.m.f. being decreased from 6300 volts to 200 volts. Across the outer conductors of the three-wire system used are motors working the baggage elevators. The 110-volt current for arc lighting is taken from one of the outers and the neutral and even when the auxiliary lighting and the usual lighting circuit, which works at a frequency of 50, are in operation, the difference between the two frequencies can scarcely be distinguished, leaving out of consideration the fluctuations which occur when the trains are started.—Lond. *Electrician*, Jan. 7.

British Tungsten Lamp Patents.—In August, 1908, the Siemens & Halske Company applied for a patent to cover a process for manufacturing a ductile alloy of tungsten and nickel, from which filaments could be drawn and the nickel afterward removed by heating. Opposition was entered to the grant of this patent by the British Thomson-Houston Company, which alleged that a patent granted in 1907 to Mr. W. C. Arsem and assigned to it, was a master patent covering all processes of forming filaments by first mixing tungsten with a softer metal to form a ductile alloy from which the foreign metal can afterward be extracted. The Acting Comptroller-General decided in favor of the British Thomson-Houston Company, but allowed the grant of a patent with certain amendments to the specifications, including a reference to the Arsem patent. The Siemens & Halske Company has appealed against this decision, however.—Lond. *Elec. Eng'ing*, Jan. 6.

Tungsten-Filament Lamp.—A note on a recent British patent of Mr. C. H. Weber (16,328, Dec. 30, 1909). Tungsten powder in a state of fine division is subjected to the action of pyridine or quinoline. This is done by mixing, for instance, pyridine (C_5H_5N) with alcohol, and causing the mixture to trickle slowly through the tungsten powder. The powder takes up the solution, and a certain amount of chemical action takes place. The product oxidizes less readily than pure tungsten, and requires the addition of only a small amount of a binding agent for squirting. The binding agent is removed from the filaments by heating in a vacuum at 800 deg. C. and the filaments are sintered in an inert atmosphere at 3000 deg. C.—Lond. *Elec. Eng'ing*, Jan. 6.

Generation, Transmission and Distribution.

Transmission of Energy from Blast-Furnace Gas Plants.—VON HOLT.—The author compares the cost of generating electrical energy in a steam plant with the cost of energy trans-

mitted from a distant gas-engine electric plant operated with blast-furnace gas. In this comparison the price of the blast-furnace gas is figured as equivalent to that amount of coal which raises the same amount of steam as can be raised with the gas. The author calculates how much less under certain conditions 1 kw-hour costs when transmitted from a gas plant than when generated in a steam plant, and gives a diagram showing the distances to which energy can be economically transmitted from a gas plant. He thinks that the distribution of electrical energy from a blast-furnace plant to the neighboring district is in general very promising.—*Elek. Zeit.*, Jan. 13.

Steam Turbines.—G. R. Parker.—A paper on the relation of the steam turbine to modern central-station practice. Modern steam-turbine practice has advanced so rapidly in the past few years that quite startling changes have been effected in some of the original turbine stations. Improvements in details of construction and increase in speed have greatly reduced the size and weight per kilowatt. In several cases it has been economical to throw out steam turbines only three or four years old and replace them by new ones, for the following reasons: The larger machines could be installed without increase of floor space. The improvement in economy represented an annual charge which, if capitalized, would more than pay for the additional investment. Practically no new auxiliary apparatus or station piping would be required. The author finally discusses briefly the low-pressure turbine.—*Gen. Elec. Rev.*, February.

Buenos Ayres.—M. Gensch.—The first part of a long illustrated description of the boiler plant of the electricity works in Buenos Ayres. The author gives a review of the development of this station, which produces 111,000,000 kw-hours per year, or 90 kw-hours per inhabitant a year (against 60 kw-hours in one of the largest German works). A large new station is now being erected, the first part of which, of 30,000 kw, is about to be opened, while the station is planned for a final equipment of 75,000 kw. The author then begins to deal in detail with the boiler plant. The article is to be concluded.—*Elek. Zeit.*, Jan. 13.

Traction.

Turbo-Electric Locomotives.—An anonymous communication on a trial of a turbo-electric locomotive made by a British company. The principle of the locomotive is to generate electricity by means of a steam turbo-generator and deliver it to motors which are coupled to the driving wheels. Use is made of a single turbo-generator of 1000 kw generating direct current. There are four series-wound motors, which are arranged to work at e.m.fs. of from 200 volts to 600 volts, and by this means considerable variation of torque may be obtained to suit the diverse conditions of running. The criticism is raised that particulars of this idea have been given out before the system has been really worked out. The chief technical criticism which is made is that the turbo-electric system employing direct current will be unsatisfactory even if it is not doomed to entire failure by reason of the commutator. It is thought that alternating current must be employed.—Lond. *Electrician*, Jan. 7.

Installations, Systems and Appliances.

Location of Central Stations.—G. Deuz.—A mathematical discussion of the principles determining the choice of a central station for a given locality.—*La Lumière Elec.*, Jan. 8.

Direct-Current Boosters and Balancers.—W. A. Ker.—The full paper with many diagrams, an abstract of which was recently noticed in the Digest.—Lond. *Electrician*, Jan. 7.

Wires, Wiring and Conduits.

Cables in Mines.—J. P. Simpson.—An article on cables in shafts and main haulage ways. The writer has found that the best class of cable for shaft work is that in which the conductors are insulated with bitumen compound, and the spaces between the insulated cores are filled with jute mixed with a plastic compound, so as to keep any moisture from creeping in. Two layers of cotton tape, soaked in compound, are wound over the jute, and, on the top of this, marline is wound on spirally so as to give a round surface for the armoring; two layers of marline are wound in opposite directions over the armoring, and the whole is compounded together. Cables of this description installed in very wet shafts have been at work for over two years at a pressure of 2000 volts, and have never given the slightest trouble. Shaft cable should always be installed in one length, where possible. Where the cable comes out of the shaft into the seam it should be protected against anything falling down the shaft onto the cable; all that is necessary is to fix strong timber over the bend in a sloping position, so as to allow water or anything that may fall to run off. The cables in the main haulage are liable to risks not encountered by any other part of the installation. Lead-covered cable should never be used for underground work. The only cables suitable for this class of work are (1) vulcanized india rubber, braided; (2) vulcanized india rubber, protected by galvanized wire or steel tape; (3) bitumen cables protected by steel armoring. The system in use will, to a certain extent, determine the class of cable to be employed, but the writer is of opinion that nothing but armored cables should be used in a mine, especially in the main haulage ways. The author discusses in detail the best methods of installation and some mistakes which are often made.—Supplement to *Elec. Eng'ing*, Jan. 6.

Transmission Line Calculations.—M. W. Franklin.—In a continuation of his long mathematical article the author deals now with the capacity, reactance and charging current of a transmission line.—*Gen. Elec. Rev.*, February.

Electrophysics and Magnetism.

Hall Effect.—A. W. Smith.—An account of an extended investigation of the variation of the Hall effect in different metals with the change of temperature. The temperature coefficient of the Hall effect in gold, zinc, platinum, silver and aluminum has for the first time been determined with certainty, and it has been found that with the exception of aluminum there is in each case a decrease in the effect as the temperature is raised from — 190 deg. to about + 22 deg. In the case of aluminum there is an increase instead of a decrease. The Hall electromotive force in each of these metals at the temperature of liquid air is proportional to the magnetic field. The relation between the Hall electromotive force and the magnetic field was examined in iron, nickel and cobalt for a number of temperatures between — 190 deg. C. and + 1100 deg. C. For a given magnetic field the Hall effect in these metals increases with rising temperature until the critical temperature of the metal in question has been reached. The rate of increase becomes the greater the nearer the critical temperature is approached. In passing the critical temperature the effect sinks rapidly to a small fraction of its original value and then in the case of iron and nickel, and probably in cobalt, decreases slowly with further rise of temperature. In the magnetic metals, for any particular temperature the Hall electromotive force is proportional to the magnetic field, until the maximum intensity of magnetization in the plate has been reached. After this condition, which has been called saturation, has been reached, the curves showing the relation between the Hall electromotive force and the magnetic fields are nearly parallel to the axis of magnetic fields. With increasing temperature the fields necessary to produce saturation become less in nickel and iron. In cobalt, however, the fields for saturation become greater with rising temperature until 300 deg. is reached and with further rise of temperature the fields for saturation become less.—*Physical Review*, January.

Ratio of Electric Charge to Mass of Electrons.—C. A. Proctor.—The variation of the ratio of charge to mass with the velocity of an electromagnetic mass has been formerly studied with the aid of the beta rays from radium, in order to decide between the Lorentz-Einstein and the Abraham theories. The results appeared to favor the former. The present author has studied the same variation by measurements of cathode rays in a very high vacuum, and while his investigation has not yet been concluded the results so far obtained are in much closer

agreement with the Abraham than with the Lorentz theory.—*Physical Review,* January.

Moments of Elementary Magnets.—An abstract of an American Physical Society paper on the absolute value of the moments of elementary magnets. The moments of the molecular magnets play a fundamental role in the theory of magnetism. The electron theory of ferro-magnetism, due to Prof. P. Weiss, allows the determination of the moments of the molecular magnet of iron, nickel and magnetite. It appears that the molecular magnet of iron contains two atoms, that of nickel six, while each molecule of magnetite Fe_3O_4 constitutes an elementary magnet. From the moments of the molecular magnets the number of atoms of hydrogen per unit volume can be derived, and the value thus determined coincides with that deduced from radioactive phenomena by Rutherford.—*Phys. Review,* January.

Magnetic Properties of Electrolytic Iron.—E. M. TERRY.—An account of an extended investigation of the effect of the temperature on the magnetic properties of electrolytic iron. The temperature was varied between that of liquid air up to the transformation point. Freshly prepared iron is very hard magnetically. Different samples show at low fields marked dissimilarities, which disappear upon heating to 1000 deg. C. At high fields, all samples are quite similar, the value obtained for susceptibility being intermediate between those found by Leich and Schild. Plunging into liquid air produces no permanent hardening. The retentivity has a maximum in the neighborhood of room temperature. Ferro-magnetism reappears on cooling at the same temperature at which it disappears on heating; this temperature is 785 deg. C. The best temperature for annealing is 1100 deg. C.—*Physical Review,* January.

Heusler Alloys.—Abstracts of three papers presented recently before the American Physical Society. A. A. Knowlton discussed the preparations and properties of the Heusler alloys and concluded that the ferro-magnetism of a Heusler alloy depends upon molecular grouping and is, therefore, a crystalline rather than a molecular property. In a second paper A. A. Knowlton and O. C. Clifford gave further experimental results on the magnetic properties of these alloys. E. B. Stephenson discussed the change of the magnetic properties of these alloys with the heat treatment to which they were subjected.—*Physical Review,* January.

Electrical Theory.—E. E. FOURNIER D'ALBE.—A review of the chief contributions to electrical theory during the past five years. The author describes briefly the function of a physical theory, deals with the question whether the ether exists, and then discusses the mechanical theories of electricity, the principle of relativity, absolute motion and aberration. The article is to be concluded.—Lond. *Electrician,* Jan. 7.

Electrochemistry and Batteries.

Nickel-Iron Storage Battery.—J. A. MONTPELLIER.—An account of tests of the Gouin-Marseille storage battery made at the Central Electrical Laboratory of Paris. The principal reaction of this storage battery appears to be the same as in the Edison nickel-iron battery, but the construction is different. The cell under test was 28.2 cm high with a base 12 cm x 8 cm. It had five positive and six negative plates. The positive plates are made up of pure nickel tubes which are perforated and overwound by wires of the same metal. Each tube is filled with hydroxide of nickel, thus ensuring a good contact between the active mass and the surrounding tubes. When these tubes are filled, each end is closed by stoppers of ebonite, and they are arranged to the number of 29, horizontally between two vertical U-shaped nickel supports to which they are riveted. A cross-piece at the top joins the two supports and forms the means of connection to the external circuit. Each positive plate weighs 540 gms, of which about 300 gms are made up of the active material. The "capacity" of each plate is 37 amp-hours on an eight-hour discharge rate, the potential difference at the terminals and at the end of this time being 0.5 volt and the average potential difference 1 volt. The negative plates are made up of two strips of pure iron sheet folded together several times, and are riveted at each end into two strips of nickel. Each plate is made up of 12 such rolls fixed horizontally. The negative plate has a cross-piece at the bottom as well as at the top. The metal strip is oxidized by a special process, thus allowing a very rapid reduction of the oxide formed, and at the same time ensuring that it shall adhere firmly to its support. The weight of a negative plate is 140 gms, and its capacity is 15.4 amp-hours. The electrolyte is a 20 per cent solution of caustic potash. The cell tested weighed 6.3 kg, which could be easily reduced to 5.8 kg by using a thinner and smaller ebonite container and thus decreasing the amount of electrolyte required. Further, by arranging the iron rolls vertically the horizontal supports might be dispensed with. According to the report received from the Laboratoire Central d'Electricité, the e.m.f. of a cell is 1.55 volts after having been charged for 12 hours with a current of 30 amp. When the cell was discharged for eight hours with a current of 20 amp the e.m.f. fell gradually from 1.45 volts to 0.475 volt, giving a cell capacity of nearly 160 amp-hours, or 25.38 amp-hours per kilogram of cell. Fig. 3 has been prepared from these results,

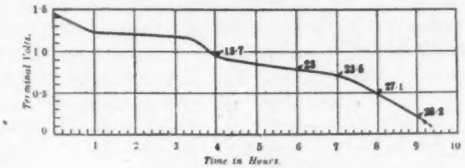


Fig. 3.—Discharge Curve.

the figures on the curve being watt-hours per kilogram of complete cell, calculated on the assumption that the weight of the cell was 5.8 kg.—Lond. *Electrician,* Jan. 7.

Units, Measurements and Instruments.

Mercury-Jet Interrupter.—An illustrated description of a new improved mercury interrupter of H. W. Cox & Company, shown at the recent exhibition of the London Physical Society. Any current up to 30 amp may be passed without injury to the break; and the current passing through the coil can be varied from practically zero to the maximum without wasting energy in resistance. By a special arrangement a large resistor, having a resistance of approximately 200 ohms, is put into circuit at the moment the current is "made" and is gradually taken out, so that when the current is "broken" the resistance in circuit is practically nil; consequently, a minimum amount of inverse current is induced in the induction coil. This latter is a most important factor in X-ray work. A quick screw thread, the end of which is shown at *A* (Fig. 4), is cut

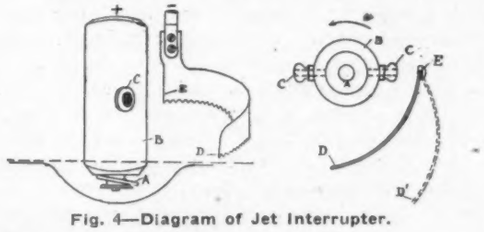


Fig. 4—Diagram of Jet Interrupter.

internally upon the barrel *B*, which, being driven by an electric motor, pumps up mercury from the reservoir and discharges it from two nozzles *C*. The mercury stream during part of its revolution strikes against the fixed blade, making contact at the point *D* and breaking at *E*. By swinging the blade the arc of contact is increased or decreased, and the time allowed the current to build up in the primary circuit of the coil is varied at will. The nozzle is shaped in such a manner that shortly after leaving it the mercury stream begins to split up and to form nodes or constricted portions having considerable resistance; consequently, at *D* or *D'* the resistance in circuit is very considerable, and this resistance is gradually removed until when the break occurs at *E* the only resistance is that of ¼ in. of solid mercury jet, which is practically nil.—Lond. *Electrician,* Jan. 7.

Telegraphy, Telephony and Signals.

Pupin System of Loaded Telephone Lines.—A. Ebeling.—A lecture held before the Berlin Electrical Society on the results of German practice with the Pupin system of inserting inductance coils at regular intervals in overhead telephone lines. The first question investigated related to protection against lightning. These experiments were made on the line from Berlin to Magdeburg, where there are many thunder storms. After a short time several unprotected coils were destroyed during a heavy thunder storm and the necessity of protecting the Pupin coils against such accidents became evident. This was done in a very simple way by shunting the coils with a lightning arrester, as shown in Fig. 5, and subsequently no Pupin coils were destroyed. On the first lines equipped with the Pupin system single inductance coils were employed—that is, coils were inserted in one conductor and other coils in the return conductor. The line from Berlin to Frankfort was first equipped and inductance coils each of 8.7 ohms and 0.11 henry were inserted at distances of 5 km (three miles). The following table gives the theoretical figures for the line:

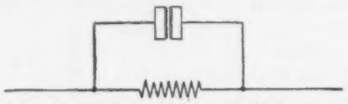


Fig. 5.—Diagram of Loaded Telephone Line.

	Effective resistance in ohms, per km loop.	Self-induction in henry, per km loop.	Mutual capacity per km in microfarads.	Damping constant.
5 mm (200 mils) bronze...	1.92	0.00186	0.0063	0.00176
4 mm (160 mils) bronze...	3.00	0.00194	0.0060	0.00262
2.5 mm (100 mils) bronze without Pupin coils.....	7.70	0.00214	0.0055	0.00591
2.5 mm (100 mils) bronze with Pupin coils.....	11.18	0.04610	0.0055	0.00193

The product of the damping constant and length of line is 0.95 for the 5-mm line, 1.52 for the 4-mm line, 3.43 for the 2.5-mm line without Pupin coils and 1.12 for the 2.5-mm line with Pupin coils. The smaller the value of the product of damping constant and length of line, the better is the transmission of speech. In general, a good transmission of speech requires that this product should not be greater than 1.5 and transmission of speech is still possible with a product equal to 2.5. The above figures show that the 4-mm line is about at a point where transmission of speech ceases to be good. The 2.5-mm line, without Pupin coils, must be unsatisfactory. On the other hand, the 5-mm line, without Pupin coils, and the 2.5-mm line, with Pupin coils, should give theoretically very good transmission of speech. These theoretical conclusions were tested and were in general confirmed. However, when ordinary lines of shorter length were connected to the Pupin line the efficiency of the Pupin line was decreased, due to reflections of electromagnetic waves. In general, experience showed that the 2.5-mm line, loaded with Pupin coils, was in all cases at least as good as the 4-mm line without coils. The author then discusses further telephone lines on which the Pupin system was installed and describes the gradual evolution of the design of the Pupin coils, the object being to make them as strong and non-sensitive toward temperature variation as possible. For the sake of simplicity, other lines have been equipped more recently with double coils—that is, using the same iron core for two windings which are inserted in the two conductors. The author finally discusses the economical value of the Pupin system and reaches the conclusion that a loaded Pupin line costs about one-half as much as the ordinary telephone line. The following comparative figures are given for the lines of 600 km (360 miles):

5 mm (200 mils) double line	$93,000
4.5 mm (180 mils) double line	75,000
3 mm (120 mils) double line, loaded	40,900
Saving, as compared with 4.5 mm line	34,500
Saving, as compared with 5 mm line	52,500

Since the practical construction of the Pupin coils has now reached a point where they are so compact and strong that the Pupin lines require no more care than ordinary telephone lines, most extended use should now be made of this system.—*Elek. Zeit.*, Jan. 6 and 13.

Wireless Telegraphy.—An illustrated description of the Balsillie system of wireless telegraphy. The system is a weakly-damped wave system embodying improvements in sharpness of tuning, freedom from damping, and general simplicity of parts. The action of the transmitting and receiving apparatus may be summarized as follows: An alternating-current generator energizes the primary of a step-up transformer, the secondary of which is connected to a plate-glass condenser. This condenser in turn discharges through a special form of spark-gap an inductance, to which is connected the air wire and earth. These impulses are syntonized at the receiving station by means of selective circuits, and are then caused to pass through the primary winding of a specially constructed hysteresis transformer, the secondary winding of which is connected to a telephone or other suitable form of recording or receiving device.—Lond. *Electrician*, Jan. 7.

Transmitting Pictures.—A note on a system of Ruhmer for electric transmission of pictures, use being made of the behavior of selenium when illuminated. The inventor uses screens, such as are employed in electrotyping work, and is thus able to divide up the picture he wishes to transmit into a number of sections. The apparatus employed consists essentially of a receiver, a sender, the connecting line, and a 12-volt battery. By means of a projection apparatus the picture it is required to transmit is magnified and thrown on the transmitting screen. Each division on the screen is connected to a selenium cell which is illuminated or darkened according to the light and shade of that portion of the picture falling on the particular section of the screen. The corresponding sections of the receiving screen are thus more or less lighted by the current passing through a small incandescent lamp. In this way a true picture is obtained at the receiving end. While the apparatus seems not to be new in principle, it is stated that in tests on a small scale pictures have been transmitted in less than a second, which has been heretofore impossible on account of the inertia of selenium.—Lond. *Electrician*, Jan. 7.

Miscellaneous.

Atmospheric Electricity.—Elihu Thomson.—An address summing up the present knowledge of atmospheric electricity and lightning discharges.—*Gen. Elec. Rev.*, February.

New Apparatus and Appliances

RECENT EXPERIENCES OF CENTRAL STATIONS IN FLAT RATE CONTROL.

By H. S. Knowlton.

In the great majority of central stations meter systems of charging for electrical energy consumed have for many years held pre-eminence. Since the early days of the industry flat rates have gradually lapsed into general disfavor, until to-day there are in operation relatively few contracts embodying a fixed or unchangeable bill per month or per year, except in the cases of large consumers of energy who obtain and use their service on a 10-hour or 24-hour per day basis. In many quarters, however, the feeling is growing that flat rates have been unduly abused, and there is not lacking evidence that the pendulum is about to swing in the direction of that method of charging. Recent improvements in apparatus for the control of installations using current on a flat-rate basis have placed the problem of furnishing electricity to the small consumer on an entirely new footing, compared with its condition

from 10 to 15 years ago. Within the past few months the situation has become greatly changed in the matter of flat rate applications. A number of central stations have boldly come out with plans which admit of the use of residence and commercial lighting equipment on the broad basis of a flat charge per month, and the success which has attended the exploitation of new business has been most gratifying. At Hartford, Conn.; Fulton, N. Y.; Claremont, N. H.; Concord, N. H., and Provincetown, Mass., with other developments at Buffalo, Westbrook, Maine; St. Albans, Vt.; Newburgh, N. Y., and Selma, Ala., the public has shown an immediate response to the inauguration of flat-rate offers, and with the result that the revenue per kilowatt of connected capacity has in not a few cases risen to $150 to $200 per installation per year.

In the early days of electric lighting many, if not most, companies secured their start on the basis of flat rates, but the abuse of the privilege led to its general abandonment. There was at the time no possible manner of preventing this abuse. The customer might contract with the company to use a certain maximum demand per month, and not to exceed it, but until the introduction of the demand meter there was no check upon specific installations, and no difficulty was experienced by unscrupulous consumers in substituting lamps of higher candle-power for their installations as originally laid down. Opinions differ as to the gain in favor of meter systems of charging with the public, but there is no question that more trouble has arisen from this source than from any other cause operating between companies selling electrical energy and their customers. In many respects the hardest part of the operation of an electric light and power company is the collection of revenue for current sold. When the bills are properly made out and sent to the consumer merely a step has been taken toward securing a settlement. Frequently a series of complaints are received which must be handled with the utmost tact and discretion. These complaints cover the entire range of poor service, irregularity of supply, high bills, and, last and most important of all, disputed bills. Such disputes are based on every conceivable form of objection and criticism, and when arbitrarily settled, leave the customer in an unsatisfactory state of mind. He is ready to charge that he has been unfairly dealt with, and does not hesitate to proclaim abroad that he has been robbed by a "soulless corporation."

It is indisputable that the customers of lighting and power companies have, in general, never fully appreciated the intangibility of electrical measurements, and have not only failed to appreciate, but have had practically no interest in such terms as "kw-hours," "watts," "voltage," and "current capacity." The amount of the monthly bill in United States money is the point upon which interest and appreciation center, and generally in comparison with the bill of the previous month or the corresponding month of a year ago. It is a good deal to expect the public to regard with friendliness a bill received for something which it never has seen, measured by a device which is beyond its comprehension, and whenever a disputed bill is under consideration, the average customer, regardless of his knowledge, is rarely willing to take anything but a distorted view of the situation. As a result of the meter system of charging the average person using electricity on a small scale is in every way trying to make his cost as low as possible. Each bill is carefully scrutinized and rigid instructions are given to subordinates and dependents to turn off all unnecessary lamps. It is the obsession of this belief, which, in many instances, has caused stores to close early, which keeps windows dark after closing hours, and which discourages electric sign illumination of merchants on the standard lighting rates. Unless operated on special circuits miscellaneous current-consuming devices find it hard to obtain an entrance into the domestic field, where, of all places, it is necessary to broaden out the peak load. Among many householders the incentive to cut current consumption to the lowest possible point is so firmly fixed that the minimum charge is all that prevents the lighting company from discontinuing the house lighting from lack of profit, and each householder hews as closely to the line as possible. If he exceeds his minimum he is regretful; if he falls below it he is annoyed, and feels that he is paying for something which he has not received. All this is eliminated when a contract depending upon a fixed maximum demand is made. It is needless to refer at this time to the cost of maintaining and reading meters, easily running between $10 and $12 per year on a large system.

For many years electrical minds have been bent upon the problem of designing an instrument which would protect the company from the consumer's maximum demand and at the same time serve notice upon the customer whenever the agreed-upon maximum demand was exceeded. A small number of instruments for this purpose has been developed within recent years, notably equipment perfected by Lacy in 1899, and more recently an improved form of flat-rate controller manufactured by the Excess Indicator Company, of Lynn, Mass. The latter general type came into existence commercially in 1901 in the plant of the Woburn Light, Heat & Power Company, in Massachusetts, then under the management of Mr. L. R. Wallis, and now a part of the Boston Edison system. The use of a flat-rate controller in conjunction with a residence lighting service was brought to the attention of the Massachusetts Gas and Electric Commission in connection with an appeal for lower rates against the Woburn company by citizens of Winchester, a town then served by the Woburn plant. In the presentation of this case the testimony offered before the board showed a most favorable attitude on the part of customers toward the principle of flat-rate charging. In its decision the board said, with reference to the flat-rate controller or excess indicator:

"By the use of an automatic device, every installation is to be so arranged that the customer will be unable to use at any one time more than the number of lamps in his contract, except after notice to the company. As under this plan the fixed charge is in a measure determined by agreement between the consumer and the company, instead of arbitrarily by the company upon the basis of previous consumption, it is to that extent at least an improvement.

"Such a system of charging is, we believe, absolutely unique in the electric lighting business, and there is no experience by which to reliably forecast its results. It is evidently intended to increase the profits of the company by increasing its output, and at the same time to reduce the price to a large majority of its customers, enabling them, without proportionate increase in their bills, to use lights much more freely and with increased convenience. It may be expected also in some cases of small consumption to increase the price per unit above that formerly in force, but only in cases where the ratio of hours burned to the number of lamps contracted for is very small. The operation of the automatic device for preventing the use of lights above the contract number may prove at times inconvenient and offensive, but may also be an essential feature."

The operation of the flat-rate controller is to open and close the main circuit whenever the lamps under contract are exceeded. This flickers the lamps until the excess is turned off. The flickering continues indefinitely, and is so annoying that the consumer will use every reasonable means to stop it, and soon learns that he alone suffers if he fails to keep his agreement. The range of adjustment is large, and the modern Excess instrument can be set to operate on an overload of a 4-cp incandescent lamp over a maximum demand of three 25-watt tungsten lamps; and the same instrument can be adjusted to operate on the overload of one 40-watt tungsten lamp over a contract installation of 10 40-watt lamps. The losses in the controller are nil at no load, compared with from 12 watts to 14 watts in the potential coil of the ordinary recording wattmeter. The loss at full load is shown in the above tabulation of tests by the Electrical Testing Laboratories, New York.

Watts received from mains.	Watts delivered to lamps.	Watts loss in instrument.	Volts across mains.	Volts across lamps.	Volts across instrument.
300	296	4	108.6	107.0	1.6
500	489	11	108.1	105.4	2.7
800	762	38	107.2	102.3	4.9
1,000	943	57	106.9	100.6	6.3

About 1000 Excess indicators are in use in the cities named in the foregoing paragraphs. The most conspicuous illustration of the usefulness of the flat-rate controller has occurred in connection with the introduction of tungsten lamps, particularly in competition with gas for residence illumination.

EXPERIENCE AT HARTFORD.

At the first annual convention of the New England Section of the National Electric Light Association, held at the Hotel Wentworth, Newcastle, N. H., Sept. 9 and 10, 1909, a paper was presented by Mr. Frederick W. Prince, of the Hartford Electric Light Company, on "The Low-Voltage Tungsten System in Residential Lighting." This paper was abstracted in the *Electrical World* immediately after the convention, and reviewed in considerable detail the success which the Hartford company, under the presidency of Mr. A. C. Dunham, has attained in the difficult field of residence illumination. A flat rate was made for this business from the outset, and the following proposition was made to the public:

	Per month.
Current for a 10-cp low-voltage lamp	10 cents per lamp
Current for a 20-cp low-voltage lamp	15 cents per lamp
Current for a 30-cp low-voltage lamp	25 cents per lamp

The first installation of lamps was furnished the consumer at 20 cents each for all sizes. Renewals of all sizes were charged 10 cents each. The installation of the necessary economy coil to cut the voltage down for the lamps was done by the company free of charge. The company charges a flat rate of 6 cents per lamp per month for current consumed in installations having over 10 10-cp lamps. Soon after the advent of the high-voltage tungsten and its introduction into residences on a flat-rate basis (before the low-voltage lamps were available) trouble appeared from the customers purchasing 40-watt lamps and screwing them in in place of the 25-watt units without the knowledge of the company and this fact necessitated the adoption of the Excess indicator.

When the low-voltage lamp was offered to the public in Hartford the company already had 120,000 incandescent lamps in residential service on meters, earning an average of $1.10 per lamp per year. This revenue gave the basis for the flat-rate price charged on the low-voltage lamp. The economy coil now used by the company consumes about 11 watts, and the loss of energy in this does not exceed the loss of energy in the average meter by more than 50 cents per year. Since Sept. 1, 1909, the Hartford company has installed about 12,000 10-cp lamps on a flat-rate basis. Three-fourths of the residence lighting is maintained on this basis, the 10-cp unit being by far the most popular size used. The company averages an installation of 24 lamps per economy coil installed, and has an average revenue of $2.29 per month per economy coil. It saves at least $6 per year on meter maintenance, and has not purchased a house-lighting meter for two years, whereas there was formerly required an expenditure of about $25,000 per year for meters alone. Probably less than 5 per cent of the new houses built in Hartford omit electric wiring. The standard potential used on the house circuits is 60 volts. Mr. Dunham states that when he first took hold of the business in Hartford his competitor was lighting houses at a loss. The company put in large transformers, took out small, scattered units, put in three-wire secondaries, with underground service and by careful attention made the business profitable. With the advent of the tungsten lamp the Hartford company turned to the low-voltage system as the final solution of the problem of house lighting. In the past year house lighting has increased 30 per cent in Hartford. An average of seven new contracts per day is now being signed for flat-rate residence service. The company's proposition is very attractive to wage earners and apartment-house dwellers. In each case the customer contracts for the entire number of sockets in the house. Twice as many flat-rate customers are secured as meter customers. For all lamps above the 10-cp size the company charges 12 cents per month per lamp for current. Tests on some 50 installations show that the company's lowest rate reached is 6 cents per kw-hour.

A contract blank used by the company for this class of business consists of an index card about 3¼ in. x 6 in. in size, and the principal provisions are that the consumer shall pay a fixed rate per month as stated, that he is to pay for renewals at a stated price per lamp, and that the consumer agrees not to install equipment on the circuits of greater size than specified without first receiving the permission of the company. The company uses a General Electric automatic feeder regulator and finds this to be an important and valuable piece of apparatus in connection with the maintenance of lamp life and efficiency.

EXPERIENCE AT FULTON, N. Y.

As the result of a new-business campaign in Fulton, N. Y., 26 commercial lighting contracts were obtained in 14 working days by one solicitor, with only two newspaper advertisements to pave the way. Mr. L. W. Emerick, general manager of the Fulton Light, Heat & Power Company, conducted the campaign, and the business amounted to a guaranteed gross income of $1,856, with a maximum demand of 9.6 kw, showing a revenue of $193.33 per year per kilowatt connected. Tungsten lamps were used as the foundation. The proposition was put up to the consumer practically on the basis of 1 cent per watt per month for ordinary stores and 2 cents per watt per month for late-open establishments. Thus service for a 25-watt lamp is sold at 25 cents per month to the ordinary merchant, but at 50 cents for the druggist, who is open late. Under the agreement made in Fulton the average rate charged allows the customer to burn his lamps six hours per day, which still gives the company 10 cents per kw-hour for energy consumed. With 25-watt tungsten lamps costing the customer here in the vicinity of 75 cents to 85 cents apiece, there is little reason to anticipate wilful waste. If it is found that the consumer is not living up to his agreement he is quickly brought to book by the threat of a meter installation. The few lamps located in cellars, dark closets and halls, and which in burning overtime violate the agreement, amount to very little even in the aggregate. Substitution of higher candle-power lamps is prevented by the introduction of Excess indicators.

Under the application of the flat rate with the Excess indicator the rate per kw-hour is dependent upon the length of time that the consumer uses the lamps instead of the actual number of lamps contracted for.

EXPERIENCE AT PROVINCETOWN, MASS.

The Cape Light, Heat & Power Company, of Provincetown, Mass., has now in use or under order 26 Excess indicators. The basis of flat-rate charge is 50 cents per month per 16-cp incandescent lamp. Indicators of this type have been in use in the town for six or eight months, the size varying from 10 amp to 25 amp. There are about 100 residence-lighting customers on the company's circuits. All kinds of lamps are used in connection with the indicators. Ten or 15 new customers have been gained as a result of this policy. No complaints have reached the management concerning the indicators, some being used in commercial as well as in residence illumination. The town does not maintain a day circuit, and has no gas competition, being a small seaport village on the tip end of Cape Cod. The average revenue per residence installation per Excess indicator used is $2.50 per month. The Cape company does not base its price upon the total number of outlets installed in the residence, but in no case have less than five lamps been covered.

EXPERIENCE AT CLAREMONT, N. H.

The Claremont Power Company has 24 indicators in use or on order, and the flat charge is 1 cent per watt per month. The system has been in service about four months, the 10-amp size of indicator being installed. Tungsten lamps are employed. The flat-rate scheme was introduced by a house-to-house canvass, by the use of the newspapers and by return postal-cards. Mr. L. N. Wheelock, manager, reports that four customers have been taken away from the local gas company by this plan. Twenty-two new customers for electric house lighting were gained in this small town in about 12 weeks. Customers furnish their own lamp renewals under the plan. The usual length of flat-rate contracts is one year, and the average revenue per residence installation is $1.50 per month. The minimum number of lamps contracted for is four, of the 25-watt size. The

customer can have as many outlets as he desires. The maximum number of lamps so far installed in a residence on the flat rate, controlled by the Excess indicator, is eight 25-watt units.

CAMPAIGN STARTING AT CONCORD, N. H.

Within a few weeks the Concord Electric Company, of Concord, N. H., one of the well-known Tenney companies, has advertised its readiness to sell light on the flat rate of $1 per month for four 20-cp lamps, with a charge of 25 cents per lamp per month above this number. The newspaper advertisements of the company announce that the consumer may burn the lamps night and day if necessary, and that it will wire residences at cost, wholly or in part, in case the customer does not care to have his entire house wired for service. Excess indicators are used in each installation to keep the maximum demand within the limits of each contract.

GENERAL ADVANTAGE OF SYSTEM.

Aside from the elimination of watt-hour meter troubles and annoyances this system makes it possible to materially cut down and reduce the capacity of transformers installed to handle the work of various districts. Customers are encouraged to install and operate other appliances so long as the excess provided in the contract is not passed. Under this method of charging it is possible for the central-station manager to draw a straight line across the paper to represent the sum of the demands which his flat-rate customers are entitled to make upon him, and which cannot be exceeded. This total is in almost all cases far below the total number of outlets and their capacity in all the installations served, which means that station capacity is released for other sales of energy by the use of the flat-rate controller system. With the flat rate the actual demand of the consumers will not reach the sum of their contract allowances, as a rule, for the cost of lamp renewals proves a deterrent to the continuous use of light when it is not needed. Freer burning is, of course, encouraged, but this helps to broaden the lighting peak, and so to improve the operating economy of the generating plant. The company becomes assured of a fixed income per lamp covered in the contract, and the bills to the consumer are brought so close to those he is accustomed to pay for gas that the cleaner and more flexible illumination by electricity tends to render the acceptance of such service almost irresistible. There is no question that the near future will witness a rapid extension of this method of charging and control.

BORING MACHINE FOR WIREMEN.

The accompanying illustrations show a single and double boring machine built by George Garretson, of San Diego, Cal., especially for the use of wiremen. By their use one or a pair of holes may be bored simultaneously through an elevator timber, such as an overhead joist or rafter, wall, door or window frame, etc., for the purpose of enabling electrical conductors, conduit, pipes, etc., to pass through them. The mechanism is light in weight and is operated by one person standing and looking in a natural position, who may bore holes overhead or below, 2 in. and 4 in. through. The machine is adjustable and self-supporting to the work, one hand being free most of the time. The bits feed themselves at their own rate without much friction, or may be fed to the work by means of the cord shown. It is claimed that over 300 holes may be bored in an hour with the device. After the staff and chain are adjusted, the foot of the staff is kicked or slid along the floor and the two gages or forward drop arms engage the ceiling joists to be bored. The crank is turned and the other hand rests on the feed cord hanging straight downward. Vibration of the staff is taken up by the hand of the operator and when the bits are eating through the far side of the beam a little tension is imparted to the staff. By shifting his hand from one cord to the reacting cord the operator immediately withdraws the bit or bits and the machine is free to be moved to the next timber. The device is said to work as well on loose, springy joists swaying back and forth as on solid timbers. All of the moving parts are balanced and protected within one simple one-piece casting, making the mechanism compact, relieving unequal strains and permitting aluminum to be used. In operation, the machine rests at an angle like a prop, adapting itself to uneven floors

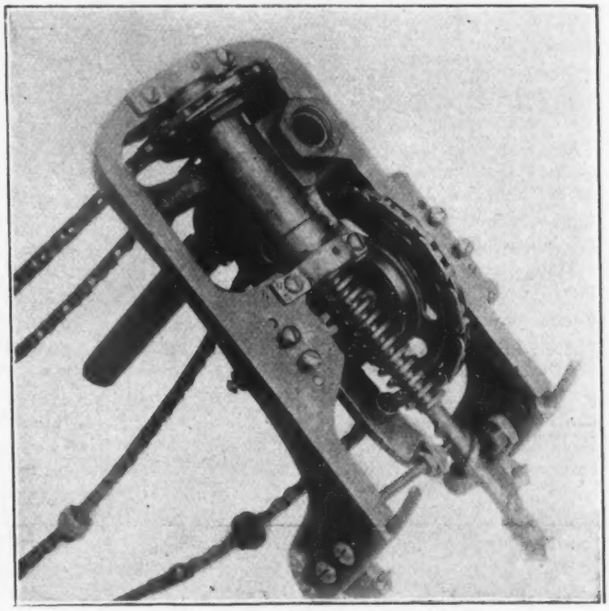


Fig. 1.—Machine for Boring Single Hole.

and permitting the operator to stand out of the way of falling chips. By means of extra drop-arm gages, extra staff and chain and fittings the device may be inverted and operated from above. The entire machine is claimed to weigh less than 23 lb. In the double boring machine the spindles are 5 in. apart and the holes pierce the joist at a slight angle so that the porcelain tubes in knob and tube work cannot jar out of position after being inserted. As will be evident from the engravings, the machines are well built for the work intended and the manufacturer claims that the saving in labor incident to their use will more than pay for the devices in a short while, not to mention the prestige which comes to a wireman who is able to perform work with the utmost speed.

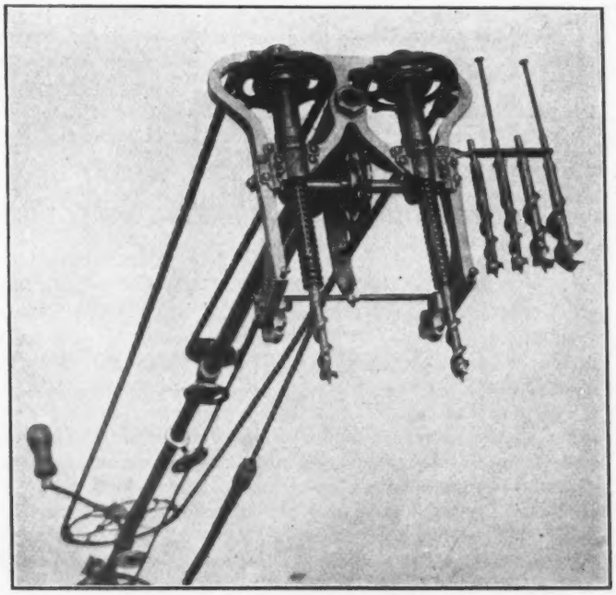


Fig. 2.—Double Boring Machine.

CHARLES F. BRUSH VISITS HIS OLD LABORATORY.

In 1881 Mr. Charles F. Brush built a private laboratory at the Brush plant in Cleveland, in which he worked out many of the important practical problems which greatly accelerated the growth of the electrical business. Mr. Brush recently visited his old laboratory and inspected with keen interest every nook and corner which told again the story of his early work. He found still in use some of the benches built in 1881. In a reminiscent way he pointed to one side of a basement room, saying that on that spot he calibrated and tested the first practical, workable voltmeter and ammeter. This instrument was made under his direction in the shops across the street. The original instruments he treasures in the laboratory maintained at his home, where he devotes a considerable portion of his time to scientific investigation. He pointed out another part of the laboratory, where he developed his first storage battery.

Many interesting anecdotes were told of the first experimental installation of arc lamps and of the founding of commercial electric lighting. These stories, coming as they did from a pioneer in the electric lighting industry, brought out most forcibly the growth and present capacity of electrical manufacturing plants. No more striking illustrations of this growth may be had than the one recalled by Mr. Brush. In 1893 the Brush Electric Company's plant, then one of the great electrical plants, covered 5½ acres. In this plant was made "everything electrical," from dynamos to incandescent and arc lamps; now, however, it is exclusively devoted to the manufacture of incandescent lamps by the member companies of the National Electric Lamp Association, and furthermore, this one branch of the industry has grown to such an extent that the member companies of the National Electric Lamp Association now employs 6000 people and has 35 acres of floor space. These tremendous resources are devoted entirely to the production of incandescent lamps.

Mr. Charles F. Brush, President Charles S. Howe, of the Case School of Applied Science, and Mr. H. R. Hatch were the guests on the occasion above referred to of Dr. Hyde, director of the Physical Laboratory of the National Electric Lamp Association. Dr. Hyde and his associates now occupy this historical laboratory, which has been remodeled and equipped for scientific research on the physics of light, the physiological and psychological phenomena of illumination, and the study of color values and color effects. Mr. Brush expressed great pleasure in finding the scene of his earliest work again the home of scientists pledged to original research, aimed directly at increasing the sum total of human knowledge on light and illumination.

MOTOR DRIVE IN A PLANING MILL.

In the beautiful old town of Greenfield, Mass., situated on the Green River not far from the point where it empties into the Connecticut, is the planing mill of the Franklin County Lumber Company, one of the best installations of electrically driven wood-working machinery to be found in the State of Massachusetts.

This mill has been running with the present equipment for about a year, although many of the wood-working machines were formerly used in the old steam-driven mill nearby, now used for storage purposes. The present planing mill, which is served by the same yards and dry kilns, is in a separate two-story brick building with basement. A detached concrete building for shavings and sawdust is removed from the mill proper by about 20 ft.

The machines are equipped with individual 60-cycle, three-phase, 220-volt Westinghouse motors, mainly of the squirrel-cage type. Power is supplied from the circuits of the Greenfield Electric Light & Power Company at 2200 volts, being stepped down by three 50-kw transformers and distributed through the mill at 220 volts. The high-tension circuit-breaker, switchboard panel, transformers and distributing panel with meter, switches and fuses are all located in a fireproof room in the basement.

The woodworking machinery consists of the usual equipment of planers, molders, lathes, sanders, band saws, re-saws, edgers,

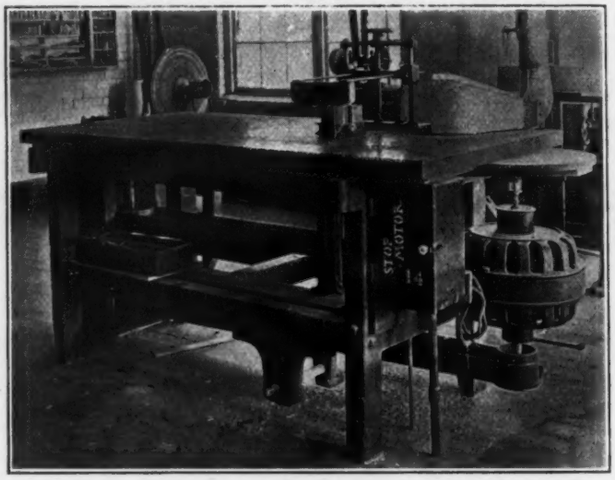


Fig. 1.—Single-Spindle Shaper Driven by Vertical Motor.

jointers, etc. There are 30 machines in all driven by motors ranging in capacity from 1 hp to 30 hp.

Most of the motors are located on the side walls, posts or ceilings, or on the ceiling of the story below and belted up through the floor. Where motors are on the floor they have been boxed in, together with their belts, making allowance for ventilation by a screen. The motors are thus protected from both dirt and dust, and accidents are prevented.

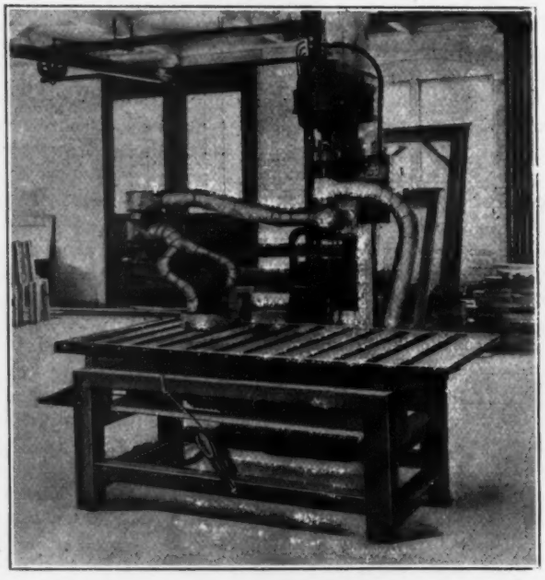


Fig. 2.—Post Sander Driven by Motor Coupled to Vertical Shaft.

The machines are piped with individual sawdust collectors, the exhaust system being supplied from a double 30-in. blower with fans direct-connected to the extended motor shaft. The shavings are carried by the collector across a roadway to the "cyclone" on the top of the shavings building, in which are separate rooms for sawdust and shavings, with chutes for delivery into wagons or to the baling press on the ground floor. This press, built by Dederick & Sons, of Albany, makes two bales at a time, each 30 in. x 16 in. x 16 in., a convenient size for handling. It is driven through a countershaft, necessary for reversing, by a 7½-hp squirrel-cage motor with a two-

point auto-starter. The motor has, of course, no moving contacts and the starting contacts are all under oil. There are no lights in the building, and the main construction is of concrete, so that the possibility of fire is reduced to the minimum.

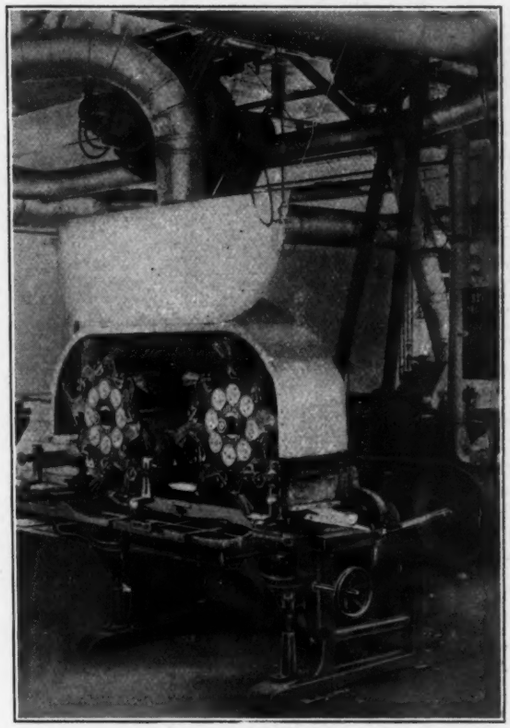


Fig. 3.—Special Molding Sander with Cover Raised to Show Sanding Brushes.

The 30 motors installed aggregate 231 hp, and the working time amounts to about 225 hours per month. However, the load factor of the plant is but 13 per cent, as the consumption has averaged approximately 6600 kw-hours per month. A large share of this is due to the blower, which runs continuously,

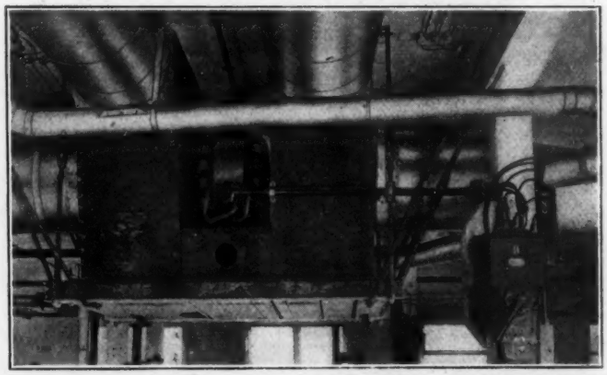


Fig. 4.—Motor-Driven Double Blower on Platform Suspended from Ceiling.

nearly loaded, although gates are installed at each machine and a notice at each presents the continual reminder "Close Gate."

POLYPHASE INDUCTION MOTOR.

The Kimball Electric Company, of Chicago, Ill., which has met with much success with its variable-speed, single-phase motors, has now, with the co-operation of Prof. John D. Nies, of Lewis Institute, designed an entirely new polyphase induction motor, which is illustrated in Fig. 1. In Fig. 2 are shown curves of performance for a 1-hp, 220-volt, 60-cycle, three-phase, four-pole Kimble motor of the new type. The new motor is made in sizes ranging from ¼ hp to 7½ hp. The curves of Fig. 2 represent graphically the characteristics of the machine. The polar area of the motors is large, and this permits the use of a much lower value of the no-load current than is

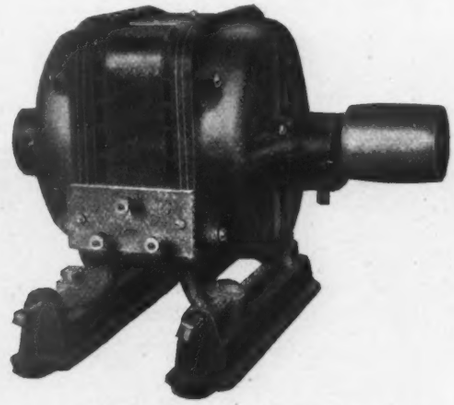


Fig. 1.—Polyphase Induction Motor.

usual. This characteristic contributes to an improvement of the power-factor at all loads and indirectly to the improvement of the efficiency through a reduction of the copper loss.

The pitch of the stator winding is chosen to give a magnetic field of maximum smoothness, the field being almost sinusoidal, so that little damping action is required of the rotor, and the losses due to stray currents in the rotor are said to amount to practically nothing. The use of the selected winding pitch results in short coil ends, leading to a reduction of the magnetic leakage and also to a reduction of the stator copper losses.

Not designed for high starting torques, but rather for low slip, these motors are nevertheless possessed of a starting torque ample for most purposes, and higher, it is said, than is usually obtained in motors of the same efficiency and slip. The results secured are due to the smoothness of the motor field, which causes any back torque due to the rotor's damping action to be eliminated.

The efficiency of these motors is high and sustained through

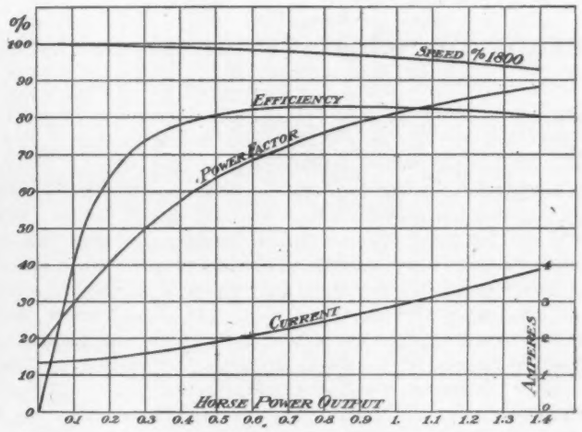


Fig. 2.—Characteristic Curves of Polyphase Induction Motor.

a wide range; the power-factor is exceptionally good, and the slip is small. The arrangement of the parts is such as to secure a free dissipation of heat, and the rating is conservative. The tendency of the design is toward shorter length and larger diameter. This feature permits the use of short, stiff shafts running in bearings of good size and set close together, so that no trouble is likely to occur on account of sprung shafts or contacts between stator and rotor iron. The outer surface of the rotor is made smooth, which, together with the smoothness of the field, makes the motor nearly noiseless in operation. This motor was exhibited for the first time at the recent Chicago Electrical Show.

ELECTRICAL GLASSWARE IN STRUCTURAL FORMS.

For the first time the Macbeth-Evans Glass Company, of Pittsburgh, Pa., exhibited at the recent Chicago Electrical Show its beautiful white Alba glass arranged in structural forms. In the accompanying picture of the exhibit, sections of this glass are shown arranged as vertical columns surrounded either by balls or by shallow bowls filled with ferns. Inside the columnar sections are linolite lamps, and the light from them

Electrical Glassware in Structural Forms.

gives the glass columns the appearance of softly glowing white marble, the effect being very pleasing to the eye. Some heat is radiated from these illuminated columns, but it is said that this drawback will be obviated by future arrangements. The hollow sections, arranged in the form of columns in the exhibit, are about 4 in. in diameter, the glass being about ½ in. thick. The exhibit also contained many other beautiful specimens of electrical glassware, but the display of Alba glass in structural forms was the most conspicuous feature and attracted the most attention.

MEETING OF TECHNICAL PUBLICITY ASSOCIATION

The thirty-fifth dinner and meeting of the Technical Publicity Association was held Jan. 20, with Secretary H. H. Kress in the chair. Mr. C. R. Lippman, advertising manager of Genuine Bangor Slate Company, Easton, Pa., suggested methods whereby members of the association collectively could gather a vast amount of advertising and merchandizing information. He also suggested the desirability of interesting the heads of firms more actively in advertising and its importance, as employers, sales managers and salesmen do not at present take proper interest in the subject. He suggested an "Employers' evening," to which the members of the association could bring managing officers of the sales departments. Mr. Geo. W. Wharton, advertising manager for Jos. P. Day, real estate operator, disclosed some interesting information as to the methods of press bureaus and press agents in influencing public opinion. Mr. H. Tipper, advertising manager of The Texas Company, told of a curious advertising situation in merchandizing his companies' product, involving as factors municipal engineers, councilmen, mayors, contractors and oftentimes property owners who are generally assessed for new pavements. The problems incident to this situation he handled principally through direct advertising.

Mr. H. M. Horr, advertising manager of the Oakland Chemical Company, spoke about "Direct Mail Advertising" and the benefits of circularizing by form letters. He pointed out that by far the greatest percentage of form letters sent out is surprisingly ineffective and proved his claim with an exhibit of some of the worst, thus adding greatly to the hilarity of the evening. Mr. Horr also stated that direct advertising has no conflict with trade paper advertising, but deserved a place in almost every well-regulated advertising campaign.

Mr. Barrett Smith, advertising manager of Stone & Webster Engineering Corporation, Boston, registered a few protests of unprofessional things in advertising practice as seen by one of professional training in another field, and offered suggestions for correction of some of the defects. Subsequently an energetic discussion on the uniform advertising contract proposed by the committee held the meeting till quite late. The proposed contract will come up for final action at the next meeting, which will be held Feb. 10.

ELECTRIC PUMPS FOR WATER SUPPLY OF LOCKPORT, N. Y.

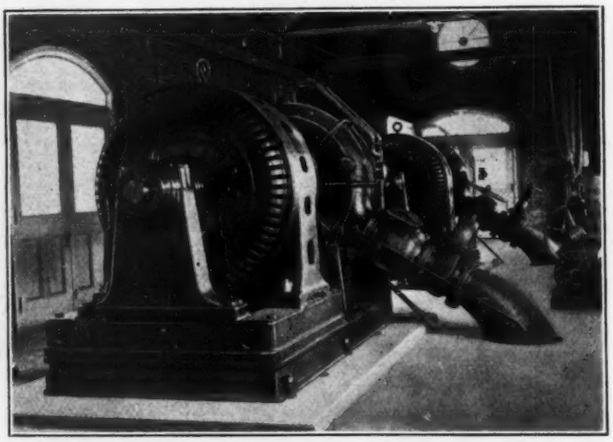
The city of Lockport, N. Y., derives its water supply from the Niagara River near North Tonawanda, 13 miles away. From the electrically driven pumping station at this point the water is forced through 69,000 ft. of 30-in. main to a standpipe, 25 ft. in diameter and 120 ft. high, at Lockport.

The pumping plant contains three independent units with a combined capacity for delivering 15,000,000 gal. in 24 hours, against a pressure of 125 lb. per square inch. Each unit comprises a 500-hp, 400-volt, three-phase Westinghouse induction motor, operating at 750 r.p.m., direct-connected to a single-suction, enclosed, impeller centrifugal pump made by the Holly Manufacturing Company, of Buffalo.

Electrical energy generated at Niagara Falls is transmitted to North Tonawanda at 22,000 volts, being stepped down to 440 volts at the pumping station by three 500-kw, oil-insulated, water-cooled transformers. This energy is supplied to Lockport at $16 per hp-year.

The three motor-driven pumping units were recently given a very complete test, which developed some interesting economies of electric operation. Each unit was run continuously for 15 hours, during which time readings of the electrical input were taken every five minutes and readings of the Venturi water meter and the pressure gage every 10 minutes.

Each pump showed an average delivery of about 237,000 gal.

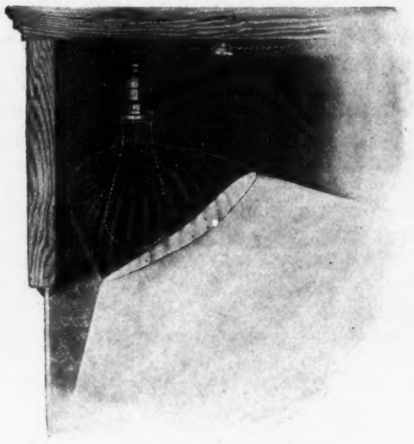


Two 500-H. P. Motor-Driven Pumping Units.

per hour, against a head of 320 ft. The motor input was approximately 343 kw for each machine, indicating an equivalent pumpage of 1450 gal. per kw-hour, and an over-all pumping efficiency of 70 per cent. The combined delivery shown by the three pumps was 17,096,000 gal. per 24 hours. In connection with this plant it may be of interest to note that last summer, when a large fire broke out, 11 powerful fire streams, through varying lengths of hose, were maintained from the standpipe and pumps as long as needed for service. The entire water supply, of which this station forms a part, as well as the station itself, was designed by Mr. Charles A. Hague, a consulting engineer of New York City.

NEW SCOOP WINDOW REFLECTOR.

The National X-Ray Reflector Company, of Chicago, has brought out a new window reflector called the Scoop. Its general form and method of installation are shown in the accompanying engraving. It is designed primarily for the use of a



Scoop Window Reflector.

60-watt tungsten lamp placed vertically. It can also be used with a 100-watt tungsten lamp in which case the distribution of light is wider than with the 60-watt lamp. It can be used with a 40-watt tungsten lamp with resultant greater concentration. This reflector is designed for the illumination of windows in which the depth is about 70 per cent of the height of the lamp above the floor of the window. In this way it occupies an intermediate position between the poke bonnet reflector which this company brought out several years ago for very deep low windows and the helmet reflector, which was designed for very high and shallow windows. This scoop reflector is so designed as to confine nearly all of the flux of light to windows of the relative dimensions before indicated, and hence allows a minimum amount of waste. By using the tungsten lamp in the vertical position the liability of early breakage is reduced to a minimum. The reflecting surface is a silver-plated mirror coating on the back of the reflector, which is protected by an elastic enamel paint, giving great durability and high efficiency.

ELECTRICAL TACHOMETER.

The accurate determination of the effective value of the rate of rotation of a revolving body calls for a more satisfactory instrument than has heretofore existed commercially, especially when indicating the r.p.m. of an internal combustion engine or wherever the rotating shaft is subject to variations in angular velocity. An otherwise fairly accurate tachometer is thereby caused to introduce error, because of the necessity of the reading being guessed at as a mean between the high and low indication of the sensitive pointer. The haphazard method of applying the tachometer shaft to the center of the power shaft and depending on manually maintaining the tachometer in the proper relation thereto is also responsible for error in reading.

The adaptation of the well-known centrifugal principle, as obtaining in certain types of engine governors, to tachometer design, introduces a thory which, while fundamentally accurate, meets, in its application, various mechanical problems such as tend to introduce inaccuracies. When the tachometer is designed to operate always with the "governor" shaft vertical, gravity can be depended upon to return the arms to normal position of no rotation. But when it becomes necessary to use the tachometer in various positions, helical spring return is usually embodied. These springs are often of wire of small diameter and relatively large number of turns, thereby being susceptible to variation through temperature changes, fatigue, etc.

It is immediately apparent that a "centrifugal" tachometer, or any type depending on the transmission of main shaft rotation to distant points, is impracticable. The natural recourse is to electrical devices, for it is evident that a properly designed generator and indicating instrument is much more dependable. Efforts have been made in this connection, but all have employed direct current as the fundamental basis. In

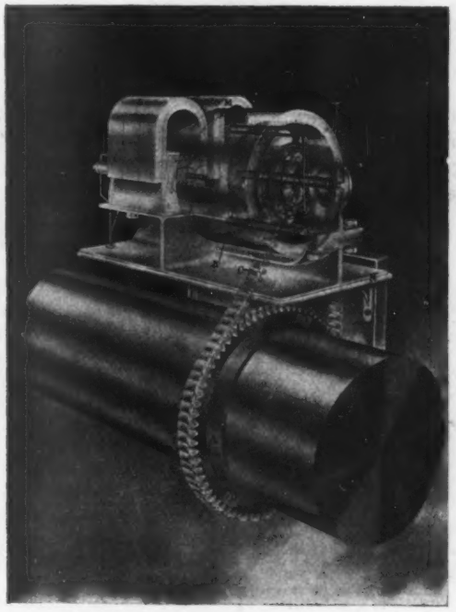


Fig. 1.—Outline View, Showing Interior Construction.

substance, a bipolar magneto, with permanent magnets and revolving armature with commutator and brushes were used, in connection with a direct-current voltmeter calibrated in r.p.m. of the main shaft or magneto armature.

The design of the Hutchison electrical tachometer, built by the Industrial Instrument Company, of Foxboro, Mass.,

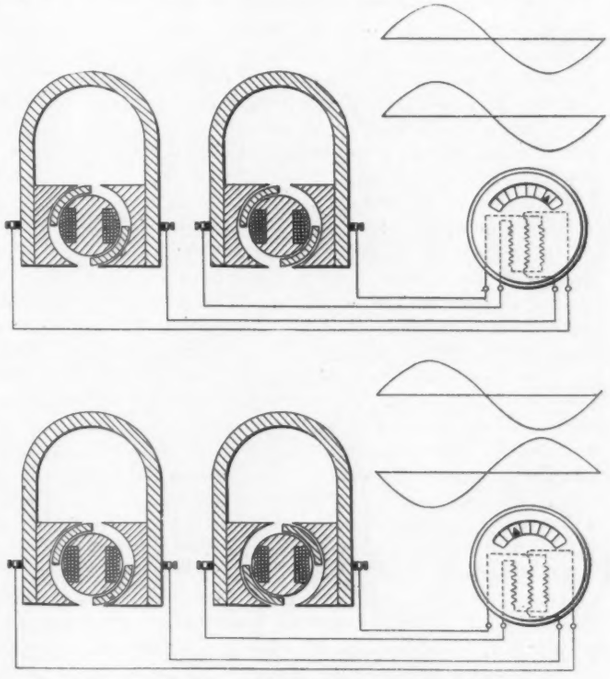


Fig. 2.—Diagram of Connections and Wave Forms.

embodies an inductor type magneto, bipolar type, with a stationary shuttle armature. Revolving between the pole pieces and armature, with but a mere mechanical clearance, is a soft-iron inductor. It is evident that there is here practically a

closed magnetic circuit at all times. In fact, in practice there is practically no stray field. The resistance and inductance of the armature are high. The terminals are led from the armature and soldered to the leads of the voltmeter. The magneto generates 125 volts at 1600 r.p.m. and the e.m.f. and r.p.m. curve is a straight line from 100 r.p.m. to 1600 r.p.m. The

Fig. 3.—Engine-Room Indicator.

indicator or voltmeter is of the dynamometer type, high resistance, properly damped. To overcome variations in angular velocity of the prime mover, a double opposed spiral spring construction is employed. The part actuated by the prime mover is rotatably mounted on the shaft actuating the magneto. One end of each of these spiral springs is connected to this part, the other end to the magneto actuating shaft. Mounted on the shaft is a flywheel of proper size and weight, depending on the conditions to be met. It is apparent that non-fluctuating rotation of the tachometer shaft is the result. Located on the top of the two-pole pieces is a variable magnetic shunt, consisting of a soft-iron piece movable longitudinally in two grooved guides attached to the pole pieces and clamped in position. This is used in calibration for specific purposes.

When it is desirable to indicate and show direction of rotation "ahead" or "astern," as in the marine type, two magnetos driven from the same countershaft are employed. Still, with the important object of avoiding all variable contacts, direction of rotation is indicated by a new arrangement of phase displacement described below.

Fig. 1 shows the merchant marine type, which, because of its importance, is illustrated here. Clamped around the propeller shaft P is split sprocket A. Rotation is imparted to the driven sprocket B by a silent chain C. Sprocket B is not keyed to shaft D, but is rotatably mounted thereon. Two oppositely coiled flat spiral springs E-E' transmit the rotation of B to the flywheel F and the shaft D, one end of each spring being attached to the sprocket B, and the other end of each to the flywheel F. Hence, any irregularity of rotation of B, caused by variations in the angular velocity of the shaft P, is smoothed out by E-E', imparting to F and D a constant resultant speed. The springs are protected against breakage from sudden reversal of P by radial arm G engaging pin H attached to the flywheel.

On the inside face of the flywheel, at the end opposite from that occupied by E-E', are cut gear teeth. These engage pinions J-K, which actuate the magnetos. Pinion K is keyed to the inductor shaft of its magneto M; but pinion J is so mounted that when the direction of rotation of main shaft P is "ahead" the inductor of magneto L is in the exact rotative relation to its armature and pole shoes as that of magneto M. The current from L is, therefore, in absolute phase with that from M. But when P is reversed in rotation, pinion J rotates idly on the shaft of the magneto L until it has traveled 90 deg. before rotating same. This causes the inductor of L to assume an exactly opposite relation to its armature and pole pieces as obtains at the same instant in M, and hence the current from L is 180 deg. electrically out of phase with M.

There are, therefore, two wires from L and two from M, running to the indicators. At "ahead" these circuits are in phase. When P rotates "astern," one is 180 deg. electrically out of phase with the other.

The voltmeter used in this tachometer is of the dynamometer type, zero center scale. Deflections to the right indicate r.p.m. ahead and to the left r.p.m. astern.

One of the magnetos is connected to the fixed or field coil of the voltmeter. The other magneto is connected to the moving coil to which is attached the pointer. When the currents in these two coils are in phase, the deflection is to the right. When out of phase, as explained, to the left. The entire unit is protected by a brass cover. The engravings are illustrative of the merchant marine type, in which any number of indicators desired are operated in multiple from the generator unit. All indicators are calibrated accurately on the magnetos with which they are to be used and the entire outfit is claimed to retain its calibration.

AUTOMOBILE ELECTRIC LAMP OUTFIT.

Every automobilist knows the troubles and inconveniences usually incident to the use of gas or oil lamps, either as headlights, sidelights or taillights. Such lamps are frequently extinguished by the jarring of a machine or more often by the wind. They also require more or less care to keep them in proper working order and to maintain their efficiency at its highest point. The demand of the owner of an automobile is a lamp that will give plenty of light, one on which he can absolutely depend and one which requires a minimum of attention.

The "Hyray" electric lamp outfit, designed by the Electric Storage Battery Company, is claimed to meet the above requirements. The lamp is furnished complete in japan or brass finish for replacing oil or gas lamps. "Hyray" fittings have also been designed that can be attached to the standard types of oil or gas lamps now in use, thus giving the advantage of the electric lamp without the necessity of purchasing entire new fixtures. The electric lamp is operated by an "Exide" storage battery which is readily carried on the running board of the machine and occupies but a small space. Switches, placed at any point convenient to the operator, turn the lights on or off, separate switches being installed to operate headlights, sidelights and taillights. The lights are switched on or off without the motorist leaving his seat. The outfits are so

Automobile Electric Lamp.

arranged that small electric lamps can be used for sidelights and taillights, while larger ones are installed in headlights, the latter being even more brilliant than the ordinary acetylene headlight. The annoyances of smoked reflectors, disagreeable odors, inability to light lamps in the wind, etc., are all eliminated in this electric lamp outfit.

LARGE FUEL-GAS POWER PLANT.

The Pierce Phosphate Company is installing a 1150-hp Westinghouse gas-engine-driven alternator set in its new generating station at Pierce, Fla., to serve as an auxiliary to the oil-power plant containing a number of Diesel oil engines. The new equipment consists of a Westinghouse single-crank horizontal gas engine, with cylinders 34 in. x 42 in., direct connected to an 850-kw Westinghouse alternating-current generator, which is employed in supplying three-phase power at 2300 volts for hydraulic mining work.

The engine is furnished with fuel gas from double-zone producers, having a calorific value of 110 lb.-Fahr. heat units per cubic foot. The new addition to the power-plant equipment represents an expenditure of about $75,000, and will operate in parallel with the old station, built some six years ago, which contains six 200-hp Diesel gas engines driving 150-kw alternators. The installation of the additional equipment is being made under the direction of Mr. A. H. Nickerson, who is the mechanical engineer for the Pierce Phosphate Company, Pebbledale, Fla.

SCHOOL TELEPHONE SYSTEM.

Some means of securing instant communication between the principal's office and the various classrooms of a school has always been found imperative. In certain schools the method used is a system of ordinary electric bells—a separate signal for

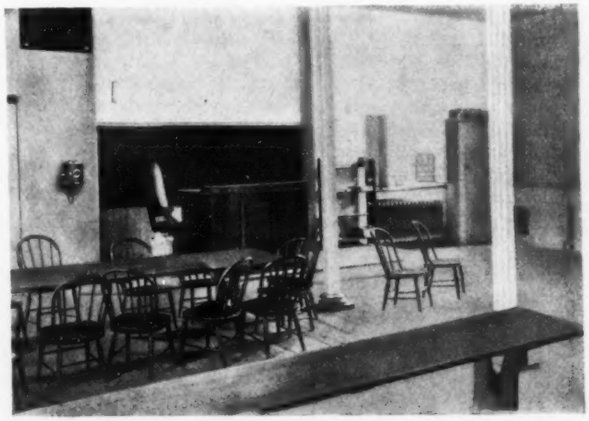


Fig. 1.—Telephone in Kindergarten Room.

each room, providing means of summoning the teachers to the office or spreading the prompt-dismissal sign, but making no provision for a teacher who may wish to call up her chief. Still other institutions use speaking tubes—somewhat an obsolete way and likely to be complicated if there are very many classrooms.

An interesting solution of the problem is afforded by the Haddonfield (N. J.) public schools. Here a private telephone system—its distributing center in the office of the supervising principal and 32 stations throughout the school buildings—is used with considerable success.

Haddonfield recently built a new high school and heating plant at a cost of $50,000. There is in this town of about 4000, not far from Philadelphia, a corps of 26 teachers and about 700 pupils. In the new high school are 14 classrooms, together with the principal's office and a large assembly-room. With the aid of the telephone equipment the principal is able to communicate at any time with any one of his teachers, with the janitor, the heating plant or any of the other stations connected to the system and scattered through five buildings.

Provision for this system was made when plans for the new schools were drawn up. Recently the city contracted with the Western Electric Company for one of its inter-phone systems, views of which are shown in the accompanying illustrations. In the principal's office is the central telephone or master station, which is connected with each of the 32 instruments in the system. The scheme is especially adapted for school purposes, consisting as it does of a number of stations arranged for telephone communication with one central station, but not furnishing communication direct from one telephone station to the other.

Fig. 2.—Master Telephone in Principal's Office.

As seen from Fig. 2, the master telephone has all the necessary connecting buttons mounted on the front of the case, each labeled with the name of the station with which it connects. The mere pushing of a button rings the bell of the telephone at the corresponding station. Conversation is then started in the usual manner by simply lifting the receiver from the hook. To call the principal's office from any one of the other stations it is only necessary to press a small button at the side of each set and proceed as before. Illustrations are shown of the inter-phones located in the principal's office, two classrooms of the high school, and of one located near the teacher's desk in the kindergarten-room.

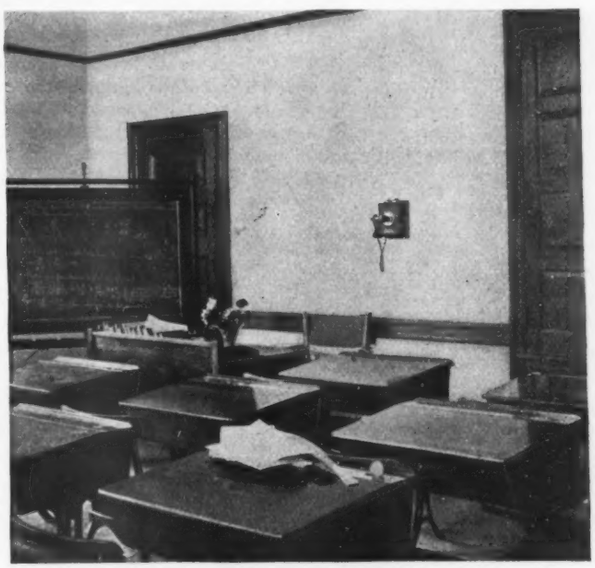


Fig. 3.—Telephone in Class Room.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There has been very little change in trade conditions during the past week that is worthy of especial mention. The wholesalers and jobbers report that excellent orders are being received for spring goods, and that traveling salesmen on the road are finding considerable encouragement among retail buyers. Many filling-in orders are also being received from merchants whose shelves have been depleted by the holiday trade. Just at the present time retail trade is somewhat quiet, owing to the fact that post-holiday sales are about concluded. The milder weather conditions throughout the West have made it possible for many transportation companies to catch up with the business which has heretofore been delayed by storms. There is no longer any anxiety over the coal supply, but there is some congestion of freight west of Chicago. Many lines of business are exhibiting evidences of conservatism, due undoubtedly to the sharp breaks in securities and cotton, and to the restless condition brought about by the high prices for the necessaries of life. In manufacturing lines every report is optimistic. Almost every branch of industry, except cotton textiles, is working at full time, and orders are being received which insure activity throughout the better part of the coming year. There is little real alarm felt over the boycott that has been started throughout the West against meats and products handled by the great packing interests. It is generally considered that this will be only temporary, and while prices have been moderated to some extent, it is not likely that they will long remain low. Collections show a tendency to improve, though as yet they are not all that could be desired. Business failures for the week ended Jan. 27, as reported by *Bradstreet's*, were 295, as against 275 the previous week, 311 in the same week of 1909, 359 in 1908, 211 in 1907 and 228 in 1906.

THE COPPER MARKET.

There have been practically no developments in the copper market during the past week that have been significant. Trading has been very dull. At home consumers have made few purchases, and while there has been some little revival of speculative interest in London it has not been sufficient to bring much encouragement to the trade. During the entire month of January a similar condition prevailed. Sales were light to domestic consumers and exports were only average. Prices, however, have been fairly well maintained—the net decline for the month being only about ¼ cent—and this is due, of course, to the fact that producers have not been pressing sales. In fact, the situation of the producer is better today than it has been for months, in spite of the scarcity of buyers. There is every reason to believe that when the Association figures are made public Feb. 10 it will be found that the surplus stock has decreased and that the production is materially shortened. Curtailment has been the order in many camps during the month and will probably be for some time to come. Another matter of encouragement is the practical completion of the merger of the Guggenheim properties and the advancement of the plans for the great consolidation of the Amalgamated and Cole-Ryan properties. These combinations tighten the grip of the leading interests upon the copper market and, if carried out successfully, will eventually make it possible to fix absolutely both production and price. In addition to these encouragements, it is generally believed in this market that while the buying has been light there has been a heavy consumption of copper by domestic consumers. Manufacturers are generally busy, and orders for electrical materials and for brass wares are plentiful. The reserve stocks in the warehouses of the factories must be rapidly growing smaller. During January imports were somewhat reduced. Exports for the month, lacking the last day, were 23,767 tons. The daily call on the Metal Exchange, Jan. 31, quoted standard copper as shown in the table.

	Bid.	Asked.	Settling price.
Spot	13.12½	13.37½	....
January	13.12½	13.37½	13.25
February	13.12½	13.37½	13.25
March	13.12½	13.37½	13.25

Market dull.

The London prices Jan. 31 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	60	17	6	60	15	0
Standard copper, futures	60	15	0	61	13	9
Market	Firm			Easy		
Sales of spot				300 tons		
Sales of futures				1,000 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			13.25c		
London, spot	£62	0	0	£60	3	9
London, futures	62	18	9	61	2	6
London, best selected	65	10	0	64	0	0

Power Consolidation in Maine.—It has been announced at Augusta, Maine, that a permanent organization will be immediately effected for the purpose of consolidating several of the power companies in Kennebec and Somerset counties into one large corporation. Acting under its charter rights, the Messalonskee Electric Company, of Waterville, will change its name to the Central Maine Power Company, and will consolidate into one ownership the following properties: Ft. Halifax Power Company, of Winslow; Sebasticook Power Company, of Pittsfield, and the Sebasticook Water Power Company, of Benton. It will also own a controlling interest in the Bingham Electric Company, Robinson Land Company, Kennebec Light & Heat Company, and in the water-power properties of the Dunn Edge Tool Company, of Oakland. The Central Maine Power Company will have exclusive franchise rights in Oakland, Pittsfield, Burnham, Augusta, Hallowell, Farmingdale, Gardner, Randolph, Pittston, Togus, Chelsea, Richmond, Manchester and a portion of Winthrop and Bingham; and franchise rights in Waterville, Benton and Winthrop. The company will own in developed water-powers about 6450 hp and in developed plants about 2200 hp. It is estimated that its undeveloped water-powers will be about 23,000 hp. A high-tension transmission line is almost completed which will connect the five power stations now in operation.

Frankfort (Kan.) Light & Power Company.—A 20-year franchise has been granted by the City Council of Frankfort, Kan., to C. E. Ridnour and D. A. Steiner to construct and operate an electric light and power plant. The name of the new company will be the Frankfort Light & Power Company. It has already been given a 10-year contract for street lighting, and will furnish energy to operate the pumps at the waterworks. The equipment will include a 60-kw, three-phase, 2200-volt generator and a 100-hp engine. It has not been determined yet whether steam, gas or crude oil will be used. It is expected that the plant will be in operation by June 1.

Maryland Hydroelectric Development.—Plans have been drawn for the construction of a large dam on the Youghiogheny River near Kendall, western Maryland, where it is estimated that 250,000 hp can be developed. The promoters propose to extend transmission lines over a radius of 50 miles, and to furnish energy to many manufacturing plants. The plans also include an extension of the Ursine & North Fork Railroad into Somerset County, Pa., opening up a rich mineral territory. It is expected that the third-rail system will be used on this railway line.

Indianapolis Municipal Plant.—The City Council of Indianapolis, Ind., is considering the question of installing a municipal electric lighting plant. Estimates have been prepared which show that a plant with sufficient output to supply all of the public lighting of the city can be established at a cost of about $1,000,000. The city is now paying $74 per lamp per year to the Indianapolis Light & Heat Company. If the municipal plan is adopted, it is proposed to have the new plant ready for service when the present contract expires in 1913.

Chicago Consolidated Traction Company.—The reorganization committee of the Chicago Consolidated Traction Company has issued notices that the underlying securities of the companies to be merged may be deposited under the reorganization plan, during the month of February, with the Harris Trust Company, of Chicago, and the Central Trust Company, of New York.

Dodge & Day with Canadian Pacific.—Dodge & Day, engineers, Philadelphia, have been retained by the Canadian Pacific Railroad to give advice concerning shop methods. The large shops at Angus, Montreal, Canada, are now being studied. The same firm has just completed the installation of a complete water-works system and electric light system for the town of Berlin, Md. Their work consisted of a survey, followed by a report to the Mayor and Council which included recommendations as to the extent to which pole and pipe lines would be justifiable. This report was approved by the Mayor and Council, who then directed Dodge & Day to make complete specifications and drawings, outlining and dividing the work into its various divisions. Contracts were then let granting Dodge & Day supervision of the work as it progressed. The Cincinnati Bickford Tool Company has retained Dodge & Day, to cooperate with them in connection with the determination of the character and extensions of its plant, to prepare plans and specifications, and to be responsible for the construction. The preliminary work has been completed and the detailed plans and specifications are in course of preparation in Dodge & Day's Philadelphia office. Construction work will commence very shortly and the plant will be ready for occupancy in the early summer of 1910. The layout includes offices and service buildings. The manufacturing department will be housed in single-story buildings with saw-tooth roofs, immediately adjacent and connected with a high bay erecting shop and warehouse. There will also be erected a carpenter shop building, smith building and an automobile garage.

Central Station Development Company.—The Central Station Development Company, Cleveland, an account of the organization of which appeared in these columns Dec. 30, 1909, has now on the press a central station handbook which will be issued about Feb. 15. The handbook, which has been under preparation for the past year, is a compilation of the best known methods used by central stations throughout the United States for exploiting the various lines of current-consuming devices. The Central Station Development Company has secured a large staff of commercial men who have had an extended experience in central-station campaigns for new business, coupled with extensive knowledge of the best-known methods for building up a central station load or of obtaining its present load. The company has for its object to engineer central station commercial departments, instructing how to lay out campaigns and organize methods for carrying them out. The offices of the company will be located in Cleveland at Euclid Avenue and East Ninth Street. Mr. E. J. Kulas is president of the company, and its work will be directed by Mr. W. H. Wissing, whose central-station commercial work several years ago in St. Louis attracted wide attention.

Central Station Power for Locomotive Works.—The Virginia Railway & Power Company has contracted with the American Locomotive Works to furnish the latter with 1000 hp for five years, at the Richmond branch of the company. This fact is taken as substantiation of the claim of the Virginia company that it is in a position to supply power to manufacturing and other industries much cheaper than these industries can manufacture their own power by privately owned generating plants. The Locomotive Works directors have, it is said, planned to make a more general use of the electric current than ever before in their large plants, finding electrically driven machinery and the electric current far more satisfactory than steam power. It is further added that the Locomotive Works have agreed that they will not consider the installation of further generating plants or machinery in their works, so long as the Virginia company supplies them with electric power on the basis of the newly drawn contract.

Big Station for Cleveland.—The Cleveland Electric Illuminating Company will use a large portion of the proceeds of its recent increase of capital stock from $6,500,000 to $10,000,000, in the construction of the large central station planned on the lake shore. The building will be 300 ft. x 720 ft., but it will be built in sections, and work on the first section will be begun in the spring. When completed, this station will develop 250,000 kw. Eighteen large turbines will find place in the building, each pumping 30,000 gal. of water per minute from the lake. It is said that the old station on the river now pumps more water for use in the boiler plant than the water-works department handles for the entire city.

Denver Gas & Electric Light Company.—General Superintendent W. J. Barker, of the Denver Gas & Electric Light Company, announces that he will purchase at once additional equipment to the extent of $300,000. This is in keeping with the company's franchise, which requires that improvements shall be made from year to year. The reduction in prices granted by the Denver Gas & Electric Light Company, it is said, will save the consumers about $140,000 a year. A suit has recently been brought against the company by D. L. Hyman, a bondholder in the Lacombe Gas Company, which was taken over in 1906. The petition demands that the bonds in the Lacombe Company be paid, and asks for the appointment of a receiver.

Suit Against Canadian Power Companies.—An action has been entered by the city corporation of Maisonneuve and Quebec against the Royal Electric Company and the Montreal Light, Heat & Power Company for the annulment of their contract on the ground that the lights furnished for the city do not meet the requirements covered by the contract. This action is the outcome of a series of disputes between the company and the municipality over the lighting system. The company claims an exclusive franchise over the streets and started an action some time ago to obtain an injunction to prevent the Dominion Light, Heat & Power Company from installing wires and giving service in the municipality. The action was dismissed by the courts.

Babcock & Wilcox Company.—As a result of the recent experience of the Winnipeg Electric Railway Company with its steam auxiliary plant in this city during the power interruption caused by the breakdown at the Lac du Bonnet generating station, the directors of the company on Jan. 20 awarded to the Babcox & Wilcox Company, Montreal, a contract for boilers aggregating 3,000 hp, to cost about $35,000, which will be used as additional reserve in the steam plant on the Assiniboine River. H. W. Weller, manager of the Babcox & Wilcox Company, who was in Winnipeg, states that the business of his company was extending very rapidly in the West and that recently a contract for 3000 hp of apparatus had been secured from the British Columbia Electric Railway Company.

Central Colorado Power Company.—It is announced that work is to be resumed in a short time on the upper part of the immense dam being constructed at Nederland, Col., for the Central Colorado Power Company. McArthur Bros. Company, the contractors, were compelled to suspend building operations last November on account of adverse weather conditions. The dam when completed will be 186 ft. high, and constructed entirely of concrete. The power plant is nearing completion, and will be ready to operate with the start of flood waters in Boulder Creek during the coming spring. The new dam will cost $600,000.

Chicago Pneumatic Tool Company.—W. O. Duntley, president of the Chicago Pneumatic Tool Company, says that no action has been taken by the board of directors as yet in regard to dividends. The matter will probably be discussed at a meeting to be held Feb. 23. He says that business in the first eight months of the last year was poor, and that the total earnings for the year were small as compared with former years, despite the fact that there was a tremendous improvement in the last few months. The prospects for 1910 he considers to be very good.

Alabama Power & Development Company.—Plans are being drawn by the Alabama Power & Development Company to extend its transmission line from Talladega, Ala., to Anniston, by way of Jackson Shoals on Choccolocco Creek. It is intended to ultimately develop the water-power at Jackson Shoals. The plant of the Anniston Electric & Gas Company will furnish the energy for operating the Talladega traction system, and for the service in the country through which the transmission line will run.

Oswegatchie (N. Y.) Light & Power Company.—The contract for constructing a large power plant near Gouverneur, N. Y., on the Oswegatchie River, has been awarded to C. D. Hodge & Company, of Watertown, N. Y., by the Oswegatchie Light & Power Company. It is proposed to build a concrete power house 50 ft. x 38 ft., and to install two turbine wheels. A 24-ft. head will be obtained, and it is expected to develop 1400 hp.

United States Light & Traction Company.—Plans are being developed to increase the plants at Albuquerque and Las Vegas, New Mex., of the United States Light & Traction Company. A new 500-kw unit will be added to the former station. A new street railway line is being constructed in Albuquerque, which will use the additional energy generated.

Western Electric Company.—Lee, Higginson & Company, of Boston and New York, have sold all of the $5,000,000 of 5 per cent bonds of the Western Electric Company which were offered recently at 99. It is said that the subscriptions totaled more than $16,000,000. The company reports that it has started in upon its new fiscal year, which began Dec. 1, under most auspicious circumstances. The order books in December showed an increase over the preceding December of about 60 per cent. The totals for December did not show an increase over those for November because November, being the last month of the fiscal year, there is always a heavy rush to get in clean-up orders. Speaking of the condition of the company, one of its officials said: "The Western Electric Company is looking forward to an increased business in 1910. This is expected not only in the business of the associated Bell telephone companies, but also with the telephone customers outside of these interests. The entire telephone business is feeling the effect of improved business conditions. Many industrial plants and central stations are drawing plans for motor equipments and electrical supplies. The indications point to a special improvement in this line of goods, as well as in cable lines and smaller appliances. The company now has about 18,000 employees at work, and the Hawthorn plants are practically being operated at full time. During the last year about $1,000,000 was spent in enlarging and increasing these shops." The stockholders' annual meeting occurs Feb. 3, in Chicago.

Kellogg Switchboard & Supply Company.—At a recent meeting of the stockholders of the Kellogg Switchboard & Supply Company, of Chicago, the following directors were elected: Messrs. J. B. Edwards, J. C. McMurray, M. L. Coffeen, F. W. Dunbar, H. S. McAuley, J. G. Kellogg and L. D. Kellogg. These directors elected officers as follows: President, L. D. Kellogg; vice-president, J. G. Kellogg; secretary and treasurer, S. Guthrie; assistant secretary and treasurer, E. S. Frasher. An increase of the capital stock of the company from $500,000 to $1,000,000 was authorized, and a stock dividend of 100 per cent was declared out of the company's surplus.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Frankfort, Kan.; Rochester, Minn.; Newark, N. J.; Newton, Ill.; Waverly, Kan.; Canterbury, N. H.; Lincoln, Neb.; Milton, Pa.; Louisville, Ga.; Torrington, Conn.; Erwin, Tenn.; Millvale, Pa.; Gouveneur, N. Y.; Palmyra, Pa.; Punxsutawney, Pa.; Greenville, S. C.; Bedford City, Va.; Albuquerque, N. M.; Las Vegas, N. M.; Oakland, Ind.; Pittsburgh, Pa., and Lemoyne, Pa.

Demand Brisk for Aluminum.—The business done by the Aluminum Company of America in 1909 shows considerable increase over the previous year, and was practically as good as any year since the organization of the company. There has been quite a large demand for aluminum wire for transmission purposes, and this is especially true with regard to electrical projects being developed in Canada. At the present time the company has on hand a liberal amount of orders, and is daily receiving inquiries from the promoters of electrical enterprises.

Good Demand for Oil Engines.—Mietz & Weiss, manufacturers of oil engines, 128 Mott Street, New York, report that the demand for oil engines was very satisfactory during the last half of 1909. The demand was mostly for small power installations rather than for individual lighting plants for private houses. The company has received a number of orders from the Navy Department for small engines to be used in operating the wireless telegraph. For this equipment the oil engine seems to be particularly well adapted.

Westinghouse Electric & Manufacturing Company.—It has been announced that during the past week the Westinghouse Electric & Manufacturing Company has put practically all of its departments to work overtime. This is the first time within three years that such a condition has existed. It is said that the rush orders at the present time are heavier than at any period in the previous eight years. More men are now employed in the shops than at any time since 1906.

Subway for Buenos Aires.—R. M. Bartleman, the American Consul-General at Buenos Aires, reports that the contract between the Anglo-Argentine Tramway Company and the Municipality of Buenos Aires, for the construction and operation of a subway system in that city, has been signed by the Mayor and the company's representatives. Under the terms of this agreement the franchise is to last for 80 years, and the first part of the line must be completed before June 1, 1914.

Electric Drive for Cotton Mill.—The Ashland Cotton Company, of Jewett City, Conn., has acquired the privilege of constructing a transmission line on private property from its power station at Hopeville, Conn., to its mill. The distance is about three miles, and the current will be transmitted at a high voltage. The mill hereafter will be operated entirely by electricity.

Increasing Wireless Manufacturing Plant.—The United Wireless Telegraph Company has recently purchased a site 200 x 200 ft. on Florence Street, Jersey City, on which will be erected a large addition to the company's manufacturing plant. The demand for wireless apparatus has been quite insistent during the past six months, making the enlargement of the factory necessary.

York Manufacturing Company.—The York Manufacturing Company, York, Pa., reports recent sales of 37 refrigerating and ice-making installations ranging in rating from 2 tons to 200 tons. The customers were distributed from Texas to Canada. Among the orders was one for two 40-ton brine cooler machines, for the Pennsylvania terminal station in New York City.

Woods Motor Vehicle Company.—The Woods Motor Vehicle Company, of Chicago, engaged in the manufacture of electric automobiles, has increased its capital stock from $150,000 to $300,000.

Financial Intelligence.

THE WEEK IN WALL STREET.

During a very dull and unsettled market prices last week reached the lowest levels for the year, and, in fact, lower records were made in many instances than at any time within the past six months. The condition of the Wall Street market is thoroughly unsatisfactory. While there are no definite news developments of an unfavorable character, there is a great deal of anxiety as to the course that may be adopted by Congress and the President in regard to corporations.

NEW YORK.

	Jan. 24.	Jan. 31.	Shares sold.		Jan. 24.	Jan. 31.	Shares sold.
All.-Ch.	13¼*	13½	1,300	Int.-Met., pfd.	56	55	41,300
All.-Ch., pfd.	47¼	46*	800	Mackay Cos.	89	89	1,800
Amal. Cop.	82½	82	289,300	Mackay C., p.	77	77	1,600
Am. D. T.	20½*	20½*	——	Man. Elev.	138*	136½	714
Am. Loc.	53¼	52½	14,200	Met. St. Ry.	25*	25*	——
Am. Loc., pfd.	112	112½*	1,450	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	76*	137½*	——	Steel, com.	84¾	82	1,612,430
Am. T. & T.	137¼	137⅜	13,305	Steel, pfd.	123⅜	123¼	12,150
B. R. T.	72⅞	72¾	35,050	W. U. T.	72¼	71½	5,035
Gen. Elec.	153½	153½	5,510	West'h., com.	73½	72	11,500
Int.-Met., com.	21½	21½	55,100	West'h., pfd.	128*	123*	300

PHILADELPHIA.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Am. Rys.	47½	47½	Phila. Elec.	14⅛	14⅛*
Elec. Co. of A.	12*	12⅛	Phila. R. T.	26⅛	27
Elec. St. B'ty.	59¼	59¾	Phila. Trac.	88⅛	88⅛
E. S. B'ty, pfd.	30	30*	Union Trac.	51½	51½

CHICAGO.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	130	128
Chi. Rs., Ser. 1	107½*	107½*	Met. El., com.	17*	17*
Chi. Rs., Ser. 2	31*	30	Met. El., pfd.	54*	56
Com. Edison	118*	116	Nat'l Carbon	109	108*
Chi. Subways	4½*	3¾*	Nat'l Car., pfd.	121*	118*

BOSTON.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Am. T. & T.	137¾	137½	Mex. Tel.	4*	3¾
Cum. Tel.	147¼	147	Mex. Tel., pfd.	6¾*	5½
Edison E. Ill.	241½	244	N. E. Tel.	136	136
Gen. Elec.	155	153*	W. T. & T.	16	15*
Mass. E. Ry.	19*	17	W. T. & T., pfd.	90½*	91*
Mass. E. R., pfd.	81	81			

* Last price quoted.
Shares sold are for week of Jan. 24 to Jan. 29.

After the decline which immediately followed the collapse of the Columbus & Hocking pool, there were spasmodic efforts made by important interests to sustain prices. Some purchases were made with this object in view, but at every rally these supporters showed a very strong inclination to get out. As a consequence of this disposition, each advance in prices brought forth selling orders, which immediately caused another break. The anxiety felt in Wall Street over the decisions, which are expected soon, in the American Tobacco Company and the Standard Oil cases by the Supreme Court is very ap-

parent. In spite of reassuring words from the White House, it is generally the opinion that, if the court rules adversely to these corporations, a number of prosecutions will be at once instituted. While the industrial companies themselves are doing well, earning liberal dividends on their capital and have prospects for continued good business, the more conservative investors prefer to have their money in bank, rather than in securities that may be attacked by the Federal administration. In addition to this uneasiness, there is no denying the fact that the spirit of optimism that was so prevalent last fall has been, to some extent, checked. The excessively high prices of the necessities of life, the general discontent of consumers and the threatened demands for higher wages are all furnishing warnings to thoughtful capitalists. The volume of trading has not been since the first of the year what might have been expected, in consideration of the easiness of the money market. In spite of the fact that on many days transactions have seemed to be quite numerous, it is well known that they have been mostly made by professional traders, and that outside buying has been very limited. The money market during the past week continued to be easy, both at home and abroad, but bankers were not particularly seeking borrowers. Quotations Jan. 31 were: Call, 2½ to 3 per cent; 90 days, 4 per cent. The quotations in the table are those of the close, Jan. 31.

Pennsylvania Water & Power Company.—The bondholders of the McCall Ferry Power Company, who purchased the property in December at foreclosure sale, have organized the Pennsylvania Water & Power Company to take over the property. This company was incorporated Jan. 13 under the laws of Pennsylvania, with a capital stock of $8,500,000 and an authorized bond issue of $12,500,000. Of these bonds $5,000,000 will remain in the treasury for future use. The new company has organized for business by electing J. E. Aldred, formerly receiver of the McCall Ferry Power Company, as president; Charles E. F. Clarke, as treasurer, and Sherman L. Lewis as secretary. The work upon the dam is being pushed forward rapidly under the supervision of the Empire Engineering Corporation. R. S. Kelsch, of Montreal, has been employed as consulting engineer. The deeds transferring the property to the new company were filed at Lancaster, Pa., Jan. 29.

Philadelphia Suburban Gas & Electric Company.—The stockholders of eight suburban companies, operating in connection with the United Gas Improvement Company on the outskirts of Philadelphia, have voted to consolidate under the name of the Philadelphia Suburban Gas & Electric Company. This company will be a subsidiary of the American Gas Company, which conducts many plants throughout the country. The new company will have a bond issue of about $10,000,000. The companies represented in the consolidation are: The Jenkintown & Cheltenham Gas Company, People's Gas Company, of Pottstown, Coatesville Gas Company, Cain Gas Company, Gas Company of Moreland, Fuel Gas Company of Moreland, Suburban Gas Company of Philadelphia and the Huntingdon Fuel, Light & Power Company. The officers of the new company will be the same as those of the American Gas Company.

Monterey Railway, Light & Power Company.—A deal has been consummated by which a group of Montreal and Toronto capitalists have purchased a large block of the preferred stock of the Monterey Railway, Light & Power Company, from J. G. White & Co. and N. W. Halsey & Co., of New York, who originally secured it in payment for the lighting plant. The company controls, in addition to the street railways and electric lighting, the entire water and sewage systems in the city of Monterey, Mexico. The capitalization of the company is $5,000,000 of 5 per cent first mortgage debenture stock, held almost entirely in England; $500,000 of preferred stock which is, by this sale, held in Montreal and Toronto, and $4,100,000 of common stock. It is understood that a public offering of the stock will be made shortly in both these places.

Brooklyn Rapid Transit Annual Meeting.—At the annual meeting of the stockholders of the Brooklyn Rapid Transit Company, Jan. 28, Bernard Gallagher, recently a member of the executive committee of the Nassau Trust Company, was elected a director to succeed the late E. H. Harriman. Mr. Gallagher is president of two subsidiary companies of the Brooklyn Rapid Transit Company, president of the Metropolitan Engineering Company and of the People's Home Supply Company. He is a director of the Manufacturers National Bank. C. D. Meneely, who has been secretary and treasurer of the Brooklyn Rapid Transit Company for some years, was also elected a director to take the place of the late William Siebert. No statement of earnings was given out at the meeting.

Rockingham (N. C.) Power Company.—It is announced that the fight of many months between conflicting interests in the Rockingham (N. C.) Power Company has been brought to a final end, and that the way is now prepared for the completion of the development. The entire property has been placed in the hands of the reorganization committee, and the committee is working out a plan for financing the proposition. While nearly $2,000,000 has been already expended at Blewitt's Falls, it is said that an equal amount will be needed to complete the work. The lands concerning which there has been so much litigation, and which were held by Hugh MacRae & Company, are also included in those which have been deeded to the reorganization committee.

Boston-Colorado Power Company.—A new company has just been formed at Boulder, Cal., called the Boston-Colorado Power Company, with a capital stock of $2,000,000 for the purpose of developing hydroelectric plants at Left Hand and Jim Creeks. A large storage reservoir is to be built at short distance below where these streams unite. The interests connected with this enterprise have recently acquired Lake Isabelle, which will be enlarged and used to store flood waters. Boston and Philadelphia capital is said to be back of the project. The energy will be used largely to operate mines owned by the same interests that have organized the company.

Western Power Company.—The Western Power Company, which is the holding company for the Great Western Power Company and for the California Electric Generating Company, has issued a circular setting forth its purpose and prospects. It claims that it will ultimately be able to develop 430,000 hp. The completed first development has a capacity of 83,000 hp. The company has no bonded indebtedness, but has outstanding 6 per cent preferred stock, $5,220,000, and common stock, $12,000,000. The subsidiary companies have issued $12,483,000 of bonds.

Hudson River Power Companies.—The plans for the rehabilitation of the Hudson River Power companies have not been entirely worked out. It is probable, however, that one corporation will be organized to take over all of the six or seven operating companies, and that this corporation will issue its securities in exchange for the stocks and bonds of the separate companies. New England capital is largely interested in these projects and it is not improbable that the management of the properties will be taken over by Stone & Webster, of Boston.

Washington, Baltimore & Annapolis.—It was announced last week that the Washington, Baltimore & Annapolis Electric Company property would remain in the same hands that originally financed the road, when the receivership is finally lifted. Although no reorganization plan has yet been put forward, it is declared that the Cleveland financiers who provided capital for the construction of the line will be interested in any plan that will place it once more on a paying basis.

American Smelters & Refining Company.—The annual statement of the American Smelters & Refining Company for the first half of its fiscal year, which ended Oct. 31, 1909, shows a decrease of $475,490 in net earnings compared with the previous year. Daniel Guggenheim, president of the company, attributes this decrease to the fact that the market prices of metals have remained as low as during the times of panic and business depression.

American District Telegraph Company.—At the annual meeting of the American District Telegraph Company, Jan. 27, Union N. Bethell, vice-president of the New York Telephone Company, was elected a director to fill a vacancy. All the other directors were re-elected. The financial statement for the year shows net earnings of $84,563, which is equal to about 2.2 per cent upon the capital stock. This is an increase of $16,457 over the year 1908.

East St. Louis Light Company Deal.—It is announced that the Consumers Light, Heat & Power Company has purchased all the poles, wires and other property of the Citizens Electric Light & Power Company in East St. Louis. At a meeting of the former company, H. P. Williams was elected president and C. A. Renard was made secretary.

Receiver Asked For Chicago & Southern Traction.—A bill asking that a receiver be appointed for the Chicago & Southern Traction Company was filed by the Western Trust & Savings Bank in the Circuit Court at Chicago on Jan. 24. The company owns an interurban electric railway which runs from 79th Street and Vincennes Road, in Chicago, to Kankakee, Ill. The complainant, which is the trustee and holder of a $300,000 note, alleges that the company is insolvent. The bill declares that Mr. William S. Reed, of Chicago, who held 996 out of 1000 bonds, has been unable to complete his part of the contract for the completion of the road, and that he caused Messrs. Clarence A. Black, Matthew Slush, J. M. Mulkey and C. J. Reilley to acquire a controlling interest in the stock of the company and enter into a contract for the completion of the contract in his place.

Funds for Subway Construction.—Mayor Gaynor of New York last week, after a conference with Theodore P. Shonts, president of the Interborough-Metropolitan Company, announced that the city can pay $20,000,000 a year for subway construction without feeling it. It was stated later that Assistant Corporation Counsel Hahlo was preparing a bill to be enacted by the legislature, which would make effective the constitutional amendment recently adopted eliminating from the calculation of the city's debts the self-sustaining dock and subway bonds. When this law is adopted it means that the city will have about $125,000,000 available for subway construction. Mayor Gaynor has expressed a determination to push rapid transit development as vigorously as possible. He intimates that there has been too much quarreling and too little action.

Chicago Railways Company's Bonds.—The proceeds of the sale of $6,000,000 Chicago Railways Company first mortgage bonds will be used to purchase new equipment and to complete the Washington Street and La Salle Street tunnels. During the past year the company has spent the proceeds from $11,000,000 in bonds in rehabilitation work. The new issue will take care of the unfinished work, and will make a total of $25,000,000 spent in rehabilitation since the partnership ordinance went into effect. The Chicago City Railway has outstanding $22,500,000 of similar bonds. The bonds have all been floated in the neighborhood of par. The Harris Trust Syndicate, of Chicago, which is handling the new issue of Chicago Railways bonds, reports that it has received more orders for them than the total amount to be sold.

Suit Against Interborough-Metropolitan.—William W. Ladd, receiver for the New York City Railway Company, has brought suit against the Interborough-Metropolitan Company for $7,348,000. This suit is the outcome of the failure on the part of the receiver to collect the $5,271,582 judgment recently granted him against the Metropolitan Securities Company. Mr. Ladd declares that as the assets of the Metropolitan Securities Company are inadequate, and as the $30,000,000 of capital stock of that company was never fully paid up, the stockholders are responsible to the extent of the unpaid amounts. The Interborough-Metropolitan Company owns 293,920 shares of the Metropolitan Securities Company stock, and on this stock Mr. Ladd claims that the amount sued for is still due.

Cuyahoga Telephone Company Changes.—Charles A. Otis of Otis & Hough, bankers and brokers, has been elected president of the Cuyahoga Telephone Company, Cleveland, to succeed E. G. Tillotson, who resigned some time ago. Mr. Otis Harry Coulby, president of the Pittsburgh Steamship Company, and Henry G. Dalton, of Picklands, Mather & Company., were chosen as members of the board of directors to take the place of A. H. Bauer, of St. Louis, and M. C. Harvey, of Cleveland. In a statement Mr. Tillotson said that he would give his attention to the firm of Tillotson & Wolcott, whose operations had become of sufficient importance to demand the attention of both of the principal men interested in it. He said that physically and financially the Cuyahoga Telephone Company is in better condition than ever before.

National Carbon Company's Earnings.—The annual report of the National Carbon Company for its fiscal year, which ended Jan. 31, will show the largest earnings in the history of the corporation. An officer of the company says that orders have been taken far ahead, and the prospects for the next fiscal year are that the earnings will be even greater than in the last. He says, however, that the increase in the dividend rate of the common stock from a 4 per cent basis to a 6 per cent basis should not be accepted as a fixed rate. It is the policy of the management to pay only whatever is equitable on that issue. The rate for any year may be as low as 4 per cent, which is the minimum figure the directors are willing to maintain.

Colorado Irrigation Bonds.—Farson, Son & Company, bankers, of Chicago, are offering $5,100,000 of 6 per cent bonds of the County of Weld, Colorado, Municipal Water Company. This is an irrigation project, by which it is expected to add 125,000 acres to the Greeley district of Colorado, now under cultivation through the use of irrigation ditches.

Aurora, Elgin & Chicago Railway Bonds.—The Aurora, Elgin & Chicago Railway Company has sold to a Cleveland firm $550,000 of first mortgage refunding 5 per cent bonds. The total amount of these bonds now outstanding is $1,950,000. The present sale, it is said, will cover the requirements of the company for 1910.

DIVIDENDS.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable March 1.

Charlestown (Mass.) Gas & Electric Company, quarterly, $2.50 per share, payable Feb. 1.

Consolidated Gas Company, New York, quarterly, 1 per cent, payable March 15.

Electric Properties Company, quarterly, 1½ per cent, payable Feb. 10.

Mobile Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Ohio Traction Company, Cincinnati, preferred, quarterly, 1¼ per cent, payable Feb. 1.

United Wire & Supply Company, preferred, quarterly, 1¾ per cent; common, quarterly, 1 per cent, extra 2 per cent, all payable Feb. 1.

West Penn Railways Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American District Telegraph Company:					
Year 1909	$549,225	$464,661	$84,563	$76,888	$7,675
Year 1908	492,896	424,790	68,106	76,888	*8,782
Columbus Railway & Light Company:					
Year 1909	2,577,202	1,290,133	1,287,069	971,707	333,227
Year 1908	2,281,951	1,185,604	1,096,347	920,253	194,889
Lake Shore Electric Railway Company:					
Year 1909	1,109,083	586,184	522,899	414,950	107,949
Year 1908	1,035,650	581,548	454,101	390,732	63,369
Massachusetts Electric Companies:					
Quarter ended Dec. 31, 1909	1,921,073	1,328,901	592,172	444,654	147,518
Quarter ended Dec. 31, 1908	1,772,655	1,297,328	475,327	432,827	42,500
North American Company:					
Year 1909	2,023,418	316,542	1,706,876	.....	.....
Year 1908	1,723,186	274,024	1,449,162	.....	.....
Philadelphia Company, Pittsburgh:					
December, 1909	1,864,979	965,074	899,905	497,766	580,865
December, 1908	1,645,243	837,971	807,272	471,944	499,230
South Side Elevated Railroad Company, Chicago:					
Year 1909	2,234,971	1,523,954	711,018	453,080	257,938
Year 1908	2,241,689	1,571,065	670,624	436,620	234,004
Toledo Railways & Light Company:					
Year 1909	2,730,396	1,526,120	1,204,276	879,503	327,554
Year 1908	2,538,633	1,377,022	1,161,611	851,782	313,307
Tri-City Railway & Light Company:					
Year 1909	2,038,728	1,148,141	890,587	.....	.....
Year 1908	1,819,077	1,069,317	749,760	.....	.....
Union Electric Light & Power Company, St. Louis:					
Year 1909	3,085,614	1,503,034	1,582,580	834,204	748,376
Year 1908	3,013,297	1,551,156	1,462,141	805,499	656,643

*Deficit.

General News

Construction News.

BESSEMER, ALA.—The city is reported to be considering the question of constructing a municipal electric-light plant. It is estimated that a plant with sufficient output to supply 20,000 lamps of 16 cp could be erected at a cost of from $80,000 to $100,000. William Hugh McEnery is city engineer.

TALLADEGA, ALA.—Arrangements are being made by the Alabama Power & Development Company to extend its transmission lines to Anniston, by the way of Jackson Shoals, on Choccolocco Creek, and ultimately to develop power at the shoals. The plant of the Anniston Electric & Gas Company will furnish electricity for operating the Talladega system and for the service furnished in the country through which the transmission line will run. R. A. Mitchell, of Gadsden, Ala., is president of the company; R. L. Rand, of Anniston, Ala., general manager. J. T. Wolfe is manager of the Talladega plant.

PHOENIX, ARIZ.—At an election to be held Feb. 24 the citizens will vote on the proposition to issue $30,000 to establish a municipal electric, gas and power plant.

TEMPE, ARIZ.—The city of Tempe is contemplating the construction of a municipal electric-light plant, for which bonds to the amount of $25,000 will be issued.

HAMBURG, ARK.—It is reported that the city contemplates establishing an electric-light plant, to cost $30,000. For further information address Dr. W. L. Blanks.

BANNING, CAL.—An election will be held in February to vote on the proposition to establish and maintain a street lighting system in Banning. A. B. Pilch is county clerk.

MERCED, CAL.—The Merced Falls Gas & Electric Company is preparing plans for the construction of a new steel frame concrete substation in Merced, and also extension of transmission lines to furnish electricity for pumping and other purposes. H. H. Adams is local manager.

OAKLAND, CAL.—Arrangements are being made by the Home Telephone Company, of Oakland, for expensive improvements and extensions to its system in Alameda, which will involve an expenditure of about $500,000 and include the erection of an exchange in Alameda and the installation of a system of underground wires.

PASADENA, CAL.—The Pasadena Park Tract Land & Water Company, it is reported, will install a water system, with power plant and pumps. The directors are M. T. Weeks, E. S. Crump and H. B. Boyle.

SACRAMENTO, CAL.—Preparations are being made by the Great Western Power Company for the construction of a large warehouse in addition to the steel and concrete substation to be erected at Eighth and R Streets in Sacramento, bids for which have already been received. The transmission lines, laterals leading from the arteries on the main system and the transformer house at Oak Park have been completed. Joseph Shaw is purchasing electricity from the company for the purpose of supplying consumers in Oak Park and vicinity. The Western Power Company has completed its transmission line to the proposed site of the Western Pacific Company's shops. The company is erecting transmission lines in the delta land district, which will be used to supply electricity for pumping plants.

SAN JOSE, CAL.—The stockholders of the San Jose Railroads, the corporation which recently merged the street railways in this city, except the Interurban railway, has voted to issue bonds to the amount of $1,500,000. The First Street line will be entirely reconstructed.

STOCKTON, CAL.—Plans are being considered by the Retail Merchants' Association of Stockton for improving the street-lighting system in this city. The proposition includes an expenditure of about $30,000 for the wiring and installation of the system on the principal business streets in the central section of the city, work on which will begin as soon as plans have been adopted. It is proposed that the city shall own the distributing system and to purchase electricity. Cluster lamps will be erected on the streets and the wires placed underground.

DENVER, COL.—Plans are being considered by the Northern Colorado Power Company for the construction of a large power and irrigation project which will involve an expenditure of $10,000,000. It is stated that Boyds Lake, in Estes Park, and a series of reservoir sites to be used in connection with it will soon be turned over to the Northern company.

BRIDGEPORT, CONN.—The Board of Aldermen has accepted the contract submitted by the United Illuminating Company for the installation of magnetite lamps, superseding the present contract with the city at a reduction of about $5 per lamp per year. The contract calls for the installation of 625 or more lamps at the rate of $73 each per year, or if 700 lamps are used, $71.17 per year per lamp. Under the present contract the city pays $78.47 for each arc lamp. The new contract runs for 18 months and will save the city about $300 a month.

COLCHESTER, CONN.—The Colchester Electric Light & Power Company is reported to have purchased the old Unionville property situated about a mile northwest of the village. It is understood that the company will erect a new dam and install a power plant there. The present plant, which is being installed, will not be large enough to meet the demands for electricity for motors asked for by the different industries in the village. The transmission lines are now being erected.

EAST HAMPTON, CONN.—The electric plant of the East Haddam Electric Light Company has been closed down owing to part of the dam at Leesville being carried away. This is the second time within a month that the plant has been put out of commission, the first time by the water wheel being wrecked. The plant will not be able to furnish electrical service until the dam is repaired. E. Elmore, of Hartford, Conn., is president of the company.

TORRINGTON, CONN.—Preparations are being made by the Torrington Electric Light Company to install another 1000-hp steam turbine, the second within a year. The increase is to be made to meet the demands for electricity for motors.

DOVER, DEL.—Proposals will be received at the office of the commanding officer, Picatinny Arsenal, Dover, Del., for furnishing one fuel economizer, with engine-driven exhaust fan and stack, complete, to be installed in the power house at Picatinny Arsenal. Application for specifications should refer to ordnance supplies No. 772.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 9 for furnishing light fixtures for the U. S. public building at Newton, Kan. James Knox Taylor is supervising architect.

MULBERRY, FLA.—F. J. Howden, care Florida Mining Company, Mulberry, Fla., would like to receive prices on electrical equipment for fertilizer plant (phosphate), to consist of two small units on separate locations; gas producers to be used; the rating of the plant not yet decided.

ST. PETERSBURG, FLA.—The Bayboro Investment Company is reported to be considering plans for the construction of a street railway from Central Avenue to Bayboro.

LOUISVILLE, GA.—Steps will be taken at once by the city for the installation of a 125-hp Corliss engine and possibly a new 100-kw alternating-current generator and switchboard in the municipal electric light plant. C. E. Hix is superintendent.

VALDOSTA, GA.—The plant and holdings of the Valdosta Ice & Manufacturing Company have been purchased by G. W. Varn and associates of the Consolidated Ice & Power Company. Both companies were recently granted 20-year franchises by the City Council; the first named company was also awarded a contract for street lighting for a term of five years, which was taken over by the new company. The Valdosta company was established about 20 years ago and the Consolidated company two years ago. It is understood that the purchase price was about $100,000. The Consolidated company was contemplating the construction of new electric and ice plants, to cost about $100,000.

WAYCROSS, GA.—The street committee of the City Council has recommended the installation of 50 additional street arc lamps during the present year. The reduction in the price of electricity for arc lamps announced by the Loomis syndicate, which recently took over the property of the Waycross Electric Light & Power Company, will make it possible for the city to improve the street lighting service.

WEST POINT, GA.—Preparations are being made by the Reed Cotton Mill Company, of which E. B. Reed is treasurer, for the construction of a cotton mill in West Point, a site for which has already been obtained. Negotiations are now under way for securing electricity to operate the plant. The company wishes to secure option on 2000 hp of the water power to be developed by the Chattahoochee Power Company, of Columbus, Ga., which proposes to construct a dam and power plant on Chattahoochee River, 12 miles south of West Point. It is also understood that Mr. Reed is negotiating with the Stone & Webster syndicate, of Boston, Mass., which owns the Columbus Water Power Company, to furnish power for the mill. The Columbus company owns the water power on the Chattahoochee River just south of that owned by the Chattahoochee Power Company.

GRANGEVILLE, IDAHO.—The ranchers in the vicinity of White Bird Creek are contemplating the erection of a telephone line to Grangeville and White Bird.

DECATUR, ILL.—Plans are being considered by the Progressive Light & Power Company for the construction of an electric-light plant in Decatur. W. H. Suffern is president, and Fred M. Ives, of Decatur, Ill., secretary.

EAST ST. LOUIS, ILL.—The Consumers' Light, Heat & Power Company has purchased the plant and holdings of the Citizens' Electric Light & Power Company. The Consumers' company was organized about six months ago with a capital stock of $25,000, and was recently awarded a contract for lighting the streets and public buildings for a term of ten years from March 1, 1910, at the rate of $70 per arc lamp per year.

H. P. Williams was elected president of the Consumers' company and C. A. Renard, secretary. L. C. Haynes, president of the Citizens' company will have charge of the property until permanent officers are elected. It is expected that Mr. Haynes will be elected president.

GALESBURG, ILL.—The Galesburg Union Telephone Company contemplates making extensions and improvements to its system, which will include the installation of two additional sections to its switchboard, the rebuilding of the Knoxville line and the erection of a metallic circuit from Galesburg to Rock Island. G. B. Churchill is president of the company.

GENESEO, ILL.—The Rock River Traction Company is reported to have awarded a contract to the Northwestern Construction Company, of Milwaukee, Wis., for the construction of its proposed interurban railway from Sterling to Rock Island, Ill. The cost of the road is estimated at $1,240,000. Theodore Becker is president and William W. Cole general manager, both of Geneseo, Ill.

KIMUNDY, ILL.—The municipal electric-light plant has been purchased by J. C. Lee, of Kimundy, Ill., for $10,000. Under the terms of the sale the city is to receive payment for the plant in street-lighting service at the rate of $1,000 per year for a term of ten years. Mr. Lee writes that he would like a partner who would invest $15,000 in the plant. It is proposed to install an alternating-current system. The town has a population of about 2000.

MAROA, ILL.—The capital stock of the Maroa Mutual Telephone Company has been increased from $10,000 to $20,000.

NEWTON, ILL.—Preparations are being made for extensions and improvements to the municipal electric light plant, which will include the installation of a 1,500,000-gal. Fairbanks-Morse compound pump; a 150-hp Atlas boiler and a new street lighting system and other improvements. A. M. Holt is superintendent.

SPRINGFIELD, ILL.—The City Council is considering the question of increasing the output of the municipal electric-light plant to provide for 200 additional lamps, which will involve an expenditure of about $20,000.

SPRINGFIELD, ILL.—In a special message to the Legislature Jan. 26, Governor Deneen recommended the construction of a 9-ft. channel instead of a 14-ft. channel between Joliet and Utica, and the possible expenditure of $100,000,000 in the development of the entire 106-mile Des Plaines-Illinois channel. It is estimated that the 9-ft. channel would save $2,500,000.

WASHINGTON, ILL.—The local electric light system is reported to have been purchased by R. M. Howard, formerly manager of the Green Bay, Wis., electric light and traction systems.

BLOOMINGTON, IND.—The Showers Brothers Company, it is said, will soon purchase equipment for a power-plant equipment, with a rating of from 350 to 400 hp, including boilers, engines, generators, switchboard, heater pump and motors.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company expects to erect about 60 miles of telephone line. The work will be done by the company.

FISHERS STATION, IND.—The United States encaustic tile works and electric power plant, which was destroyed by fire Jan. 25 will be rebuilt and equipped with new machinery and power apparatus. The principal office of the company is in Indianapolis, Ind.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has submitted a proposition to the County Commissioners offering to furnish electricity for lighting and heating all the county buildings at a cost below the expense of operating the county plant. The commissioners have taken the proposition under consideration. Charles A. Bookwalter is business manager of the company.

INDIANAPOLIS, IND.—The City Council is considering the question of installing a municipal electric light plant. It is estimated that a plant with sufficient output to supply the needs of the city can be established at a cost of about $1,000,000. It is proposed to have the plant ready for operation when the present street lighting contract with the Indianapolis Light & Heat Company expires, three years hence. The city now pays $74 per lamp per year for street lamps.

LAFAYETTE, IND.—Arrangements are being made by the Indiana & Northern Traction Company for the construction of an electric railway from Monticello to Rensselaer, bids for which will be received early in the spring. G. A. H. Shiedler is president of the company.

LA PORTE, IND.—The capital stock of the La Porte Electric Company has been increased from $150,000 to $300,000. It is understood that the company proposes to make extensions to its systems and install new equipment.

MONTICELLO, IND.—In reference to an item published in the issue of Jan. 27 stating that considerable damage has been done to the plant of the Tippecanoe Electric & Power Company, of Monticello, Ind., caused by the high water and ice gorge, we are informed that no trouble has been experienced from high water and ice at the water-power plant of the company. The flood gates installed have been found to be sufficient to protect the installation.

OAKLAND, IND.—George W. Clark, secretary and manager of the Oakland City Electric Light & Power Company, writes that the company proposes to install an additional engine, generator and boiler in its plant in the near future and also other equipment to provide for a day service. It is also proposed to construct and operate an ice-making plant in connection with its lighting plant.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company is reported to be preparing to erect another dam on the St. Joseph River near the Indiana-Michigan State line.

WARSAW, IND.—Preparations are being made by the Warsaw Water & Light Company for improvements and alterations to its plant, bids for which, it is said, will soon be asked for. New machinery will be installed.

HULL, IA.—Messrs. Berkholtz & Strenfort, of Minneapolis, Minn., have been granted a franchise to erect and operate an electric-light plant in connection with their roller mill.

IRETON, IA.—The Town Council has authorized a special election to be held to vote on the proposition of granting a franchise to the Ireton Electric Light & Power Company to furnish electricity in Ireton.

MASON CITY, IA.—The Western Electric Telephone Company has appropriated $140,000 for repairs to its system during the coming year, which will include the rebuilding of the Algona line at a cost of $10,000; repairing the Sibley telephone line, recently acquired, $5,000; switchboard facilities in Mason City, $10,000; improvements at Charles City, $7,000 and at Sheldon, $4,000. Long distance lines between Mason City and Blue Earth, Minn.; from Mason City to Spencer, and from Mason City to Algona, will be improved. C. E. Yost, of Omaha, Neb., is president.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company is contemplating the purchase of a 250-hp engine next summer. H. W. Garner is purchasing agent.

SHELDON, IA.—Plans are being considered by O. E. Logan, owner of the Sheldon electric station, for the installation of an oil engine for light load and also for a day service, which is now contemplated.

VINTON, IA.—The Iowa Traction Company is reported to be contemplating the construction of a power dam across the Cedar River at Vinton.

FAIRVIEW, KAN.—A special election, it is said, will soon be held to vote on the proposition to issue $25,000 in bonds for the construction of a municipal electric-light plant.

FRANKFORT, KAN.—The City Council has granted a 20-year franchise to C. E. Ridnour and D. A. Steiner to construct and operate an electric light and power plant in Frankfort. The plant will be operated under the name of the Frankfort Light & Power Company. The company has been given a 10-year contract for street lighting and for furnishing electricity to operate the water works pumps. The equipment will include a 60-kw, three-phase, 2200-volt generator, a 100-hp engine, either steam, gas producer or crude oil. It is expected to have the plant in operation by June 1.

ST. JOHN, KAN.—The construction of a municipal electric-light plant in St. John this spring is said to be under consideration.

CYNTHIANA, KY.—Preparations are being made by the Cynthiana & Paris Railway Company to begin work on its proposed railway from Cynthiana to Lexington, via Paris, a distance of 15 miles. The company has secured a 20-year franchise in Paris. It has not been definitely decided whether to use electric or gasoline motor cars. The company is capitalized at $500,000. Robert H. Reed, of Cynthiana, Ky., is engineer in charge.

DRAKESBORO, KY.—Plans are being considered by the Elk Valley Consolidated Coal Company for construction of a central power plant to furnish electricity to operate its mines at Drakesboro, Browder and Elk Valley. C. D. M. Greer, of Memphis, Tenn., is president of the company.

PARIS, KY.—Improvements are contemplated by the Paris Electric Light Company which will involve an expenditure of about $15,000 and include the installation of new boilers, engines, generators and feed-water heaters. It is proposed to increase the output of the plant to provide for a day service.

WAVERLY, KAN.—Plans are being prepared for improvements and extension to the municipal electric light plant, which will include the installation of a 100-hp boiler, an 80-hp engine, one 50-kw alternating-current generator with exciter, complete with renewal of transformers and about 30 new meters. Extensions will also be made to the water works system. E. W. Jones is superintendent.

AUGUSTA, MAINE.—Preparations are being made to consolidate several of the power companies in Kennebec and Somerset counties. The Messalonskee Electric Company, of Waterville, Maine, will change its name to the Central Maine Power Company and will consolidate by ownership the following properties: Fort Halifax Power Company, of Winslow; Sebasticook Power Company, of Pittsfield, and Sebasticook Water Power Company, of Benton, and will also own the controlling interest in the Bingham Electric Company, Robinson Land Company, Kennebec Light & Heat Company and the water power of the Dunn Edge Tool Company, of Oakland. The Central Maine Power Company will have exclusive franchise rights in Oakland, Pittsfield, Burnham, Augusta, Hallowell, Farmingdale, Gardiner, Randolph, Pittston, Togus, Chelsea, Richmond, Manchester, a portion of Winthrop and Bingham, and franchise rights in Waterville, Fairfield, Benton and Winslow. The company will have in developed water powers a total of about 6450 hp, in developed steam plants about 2200 hp and in undeveloped water powers a total of about 23,000 hp. The company has nearly completed a high-tension transmission line connecting its five power stations in Oakland, Pittsfield, Winslow, Benton and Augusta, so that all these stations can be operated in unison.

FARMINGTON, MAINE.—The plant and holdings of the Farmington Electric Company have been purchased by the Franklin Light & Power Company, which also owns the plant at Cleveland Rips, New Portland, where a dam has been built for the purpose of furnishing electricity for lamps and motors in this village.

RUMFORD, MAINE.—The Rumford Falls Power Company has contracted with the Portland Company for the construction of another large penstock 1050 ft. in length and 14 ft. in diameter, which, it is said, will develop 7000 hp.

BALTIMORE, MD.—Preparations are being made by the Big Vein Pocahontas Coal Company, of Baltimore, Md., for extensive development of its properties, which will call for power equipment, including boilers, engines, generators, motors, etc. It is understood that considerable of the machinery has already been purchased.

KENDALL, MD.—Preparations are being made for the construction of a large dam on the Youghiogheny River, above Kendall, where it is estimated that 250,000 hp can be developed. The promoters propose to transmit electricity within a radius of 50 miles to supply manufacturing industries. The plans include the extension of the Ursine & North Fork Railroad into Somerset County, opening up a territory of rich mineral resources. Another branch will extend up White's Creek and another up to Young Valley to tap the coal fields taken over. It is expected that the third-rail system will be used. It is said that Clarkson & Company, of New York, N. Y., bankers, are interested in the project.

ATHOL, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the Athol Gas & Electric Company to issue 1532 shares of new stock at $100 per share, the proceeds to be used for the payment of outstanding obligations.

GLOUCESTER, MASS.—The Board of Water Commissioners has decided to install an electric light plant at the power station at West Gloucester to provide electricity for lighting the station. It is proposed to install an engine and generator manufactured by the B. F. Sturtevant Company, of Hyde Park, Mass.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue $80,000 in new capital stock, at $100 per share, the proceeds to be used for the acquisition of water power and real estate.

LYNN, MASS.—The Lynn Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue 1500 shares of new capital stock at $235 per share, the proceeds to be used for the funding of outstanding floating indebtedness and for additions to plant.

NORTHAMPTON, MASS.—The installation of a gas-producer power plant and electric motors to drive the machinery in its new plant is contemplated by the McCullom Company.

NORTH ADAMS, MASS.—With the completion of its new generating station, which will be put in operation next month, the North Adams Gas Light Company will put into effect a fixed power schedule, under which all consumers of electricity for motor purposes will be charged four cents per kw-hour up to 2000 kw, and two cents per kw-hour for all used in excess of 2000 kw.

WORCESTER, MASS.—The directors of the Worcester Electric Light Company on Jan. 19 voted to construct the proposed new plant on the Curtis pond property, recently purchased by the company.

WORCESTER, MASS.—The Worcester & Providence Street Railway Company is making preparations to commence work on its proposed railway as soon as the weather will permit. William E. Horne is one of the directors.

BAY CITY, MICH.—Wilbur F. Davidson, vice-president of the Chippewa River Power Company, of Port Huron, Mich., has been in Bay City making investigations in regard to furnishing electricity for lamps and motors in this city. The company recently withdrew its application for a franchise, advising the Council that it could not accept the rates proposed by the Council committee. J. L. Hudson, of Detroit, Mich., is president of the company.

HANCOCK, MICH.—Sealed proposals will be received by the Board of Public Works, Hancock, Mich., until Feb. 14 for furnishing one single-acting, triplex-plunger pump, with capacity of 350 gal. per minute, together with electric motor, switchboard and appurtenances, delivered f.o.b. at Hancock, Mich. Copies of specifications can be obtained from the city surveyor or city clerk. A. F. MacDonald is secretary of Board of Public Works.

LELAND, MICH.—Preparations are being made by the Leland Light & Power Company to extend its transmission lines to East Leland, Fountain Point, Cedar City, Glen Arbour, Maple City, Honor and Empire during the coming spring. Harry P. Spencer is general superintendent.

MUSKEGON, MICH.—The City Council has decided to submit the proposition of issuing $75,000 in bonds for the construction of a municipal electric light plant to the voters at the spring election. A report submitted to the Council shows that the city could light the streets with a municipal elecric plant for $17,000 per year, which now costs $24,000. The Muskegon Traction & Light Company now holds the contract for street lighting, which expires in June, 1911.

FARIBAULT, MINN.—It is reported that the Faribault Electric Light Company is contemplating extending its transmission line to Morristown, Waterville, Elysian, Madison Lake and Eagle Lake to supply electricity for lamps and motors.

LANCASTER, MINN.—The question of establishing an electric light plant in Lancaster, Minn., is under consideration.

ROCHESTER, MINN.—The Rochester Light, Heat & Power Company, successor to the Rochester Light & Fuel Company, is planning to enlarge its plant and proposes to supply both gas and electricity.

SHAKOPEE, MINN.—T. E. Harris, superintendent of the municipal electric light plant, writes that it is expected to start a day service in connection with the municipal electric light plant about Feb. 1.

LAUREL, MONT.—The City Council has granted the Eastern Montana Electric Railway, of Billings, Mont., a franchise to construct a street railway over certain streets in Laurel. The proposed railway will extend from Laurel to Billings and west from Laurel to Red Lodge, thence to Billings, returning to Laurel by a loop that will cover the entire Clark Fork Valley. Daniel D. Gile, 27 William Street, New York, N. Y., is vice-president of the company.

LEWISTOWN, MONT.—John L. Bright has petitioned the Council to call an election to submit the proposition to grant him an electric-lighting franchise to a vote. If the franchise is granted Mr. Bright proposes to build an electric plant to cost about $200,000.

LINCOLN, NEB.—Sealed bids will be received at the office of Roscoe C. Ozman, city clerk, Lincoln, Neb., until Feb. 24 for furnishing and erecting with concrete foundation at the Hutton lighting station one 750-hp cross compound, condensing or non-condensing engine, or one turbine of the same rating, to be direct connected to a three-phase, 60-cycle, alternating-current generator with exciter belted to engine shaft. The cost of the work is estimated at $21,835.

OMAHA, NEB.—Preparations are being made by the Nebraska Traction & Power Company for the construction of three miles of new track during 1910.

STERLING, NEB.—The Village Board has granted to C. L. Rothell, of Crab Orchard, Neb., a franchise to construct and operate an electric-light plant in Sterling.

BRISTOL, N. H.—The electric plant of the Bristol Electric Light Company, located at Newfound Lake, three miles out of Bristol, was destroyed by fire recently, causing a loss of about $25,000. The plant furnished electricity for lamps in Bristol and East Hampton, N. H.

CANTERBURY, N. H.—It is reported that the Canterbury Shakers are contemplating the installation of an electric light and power plant early in the spring. The plant will furnish electricity for lighting the village as well as for the Shaker community.

CALDWELL, N. J.—Preliminary steps have been taken by John Ottenheimer for the organization of a company to construct and operate a street railway to the suburbs of Caldwell, which at present has no transportation facilities. It is proposed to equip the railway with Edison storage-battery cars.

CAPE MAY, N. J.—At the annual meeting of the Board of Trade a resolution was adopted suggesting to the Council a new system for lighting the boardwalk by means of arches in place of the present arc lamps.

NEWARK, N. J.—Contracts have been awarded by the Public Service Corporation for the construction of an addition to its power station at Marion to the A. E. Sanford Company for foundation piling, and the Hedden Construction Company for building. The building will be 75 ft. x 100 ft. The equipment will include ten boilers and generating machinery with a rating of 18,000 kw. The company has also awarded a contract to the Cincinnati Car Company, of Cincinnati, Ohio, for 100 new cars.

TRENTON, N. J.—Bids will be received at the office of the New Jersey State Prison supervisor's office until Feb. 7 for furnishing and installing 65 hp or less in electric motors, divided into units of varying sizes to suit the needs of the different shops. Bids are to include the necessary wiring, belting and shafting, repairs to old shafting and all hangers. S. W. Kirkbridge is supervisor.

ALBUQUERQUE, N. M.—We are informed that arrangements are being made to increase the output of the Albuquerque Electric Power Company, which will include the installation of a 500-kw direct-connected unit and additional boilers. A new street-railway system is being built in Albuquerque, which will utilize part of the additional output. The Albuquerque company is controlled by the United States Light & Traction Company. C. K. Durbin, of Denver, Col., is vice-president.

LAS VEGAS, N. M.—Preparations are being made to increase the output of the plant of the Las Vegas Light & Power Company. C. K. Durbin, of Denver, Col., is secretary.

TAOS, N. M.—The County Commissioners have granted the Rio Lucerce Power Company a franchise to extend its transmission lines throughout the county. The company proposes to furnish electricity in Taos and surrounding towns.

BOLIVAR, N. Y.—The Bolivar-Wellsville Company, recently incorporated to construct an electric railway to connect Bolivar and Wellsville, 22 miles in length, has applied to the Board of Trustees of Bolivar for a franchise in this town. Application for a franchise will also be made in Wellsville. Benjamin F. Patterson, of Brooklyn, N. Y.; C. M. Vancurran and A. J. Matson, of Bolivar, N. Y., are interested in the enterprise.

BROOKLYN, N. Y.—The Public Service Commission has authorized the Kings County Electric Light & Power Company to issue $2,500,000, the

proceeds to be used for improvements, betterments and extensions to its property. The company originally applied for permission to issue $5,000,000.

GOUVERNEUR, N. Y.—The contract for constructing a large power-plant on the Oswegatchie River, near Gouverneur, N. Y., for the Oswegatchie Light & Power Company has been awarded to C. D. Hodge & Company, of Watertown, N. Y. The plans call for the construction of a concrete power-house, 50 ft. x 38 ft., and the installation of two Morgan-Smith turbine wheels. A head of 24 ft. will be obtained and 1400 hp developed.

MADISON, N. Y.—The Public Service Commission, Second Dstrict, has granted the Genesee Fruit Company permission to furnish electricity for lamps in the town of Madison.

MINEOLA, N. Y.—Preparations are being made by Doubleday, Page & Company for a new power plant to be erected at Mineola, N. Y., plans for which are now being drawn.

NEW YORK, N. Y.—Bids will be received by the president of the board of trustees, Bellevue and Allied Hospitals, Department of New York, N. Y., 411 East Twenty-sixth Street, New York, N. Y., until Feb. 8 for furnishing and installing electric and gas lighting fixtures in the pathological department and male dormitory of the new Bellevue Hospital, situated on First Avenue, between Twenty-sixth and Twenty-ninth Streets, New York, N. Y. Blank forms may be obtained at the office of the contract clerk, 419 East Twenty-sixth Street, New York, N. Y. John W. Brannan is president of board of trustees.

RENSSELAER FALLS, N. Y.—The Public Service Commission, Second District, has authorized the Rensselaer Falls Electric Lght & Power Company to increase its capital stock from $2,000 to $8,000, the proceeds to be used for paying indebtedness incurred in making additions and extensions to its plant. The company proposes to extend its transmission lines to DeKalb Junction.

SYRACUSE, N. Y.—Plans are being prepared by H. H. Gray's Sons, of Syracuse, N. Y., for the construction of a large factory in this city, together with power plant, motor, blower and sprinkler system and other machinery.

SYRACUSE, N. Y.—The Oswego River Power Transmission Company has been authorized by the Public Service Commission, Second District, to execute a mortgage to the amount of $100,000 to secure an issue of bonds for the same amount, and to issue $60,000 in bonds, to be sold at not less than 85, the proceeds to be used for the payment of outstanding obligations to the amount of $30,647, and $21,881 for new construction work. The proposed work includes the construction of substation in Baldwinsville, transmission line from Baldwinsville to Phoenix, completion of line in Baldwinsville to Oswego; substation in Fulton, reconstructing building at Phoenix and sundry equipment.

WILSON, N. Y.—We are informed that the Village of Wilson is contemplating the installation of an electric lighting system and proposes to purchase electricity from a private corporation to operate the same. As yet no arrangements have been made. William Albright is president of the village.

CLINTON, N. C.—The Garland-Clinton Telephone Company has changed its name to the Consolidated Telephone Company and increased its capital stock from $5,000 to $25,000.

DURHAM, N. C.—The Durham Traction Company, it is reported, contemplates building an addition to its power station and installing a slow-speed Corliss engine with a rating of 1500 hp.

NEWBERN, N. C.—Application has been made to the Board of Trustees for a franchise for a motor-car railway which will extend from Newbern to Trenton, a distance of about 18 miles. W. S. X. Taylor and A. E. Stevens are promoters of the project.

ROCKINGHAM, N. C.—Announcement has been made that arrangements have been made for the completion of the hydroelectric power plant of the Rockingham Power Company, work on which was started several years ago. The entire property has been placed in the hands of the reorganization committee, which is at present working out a definite plan for financing the proposition. Nearly $2,000,000 has already been expended on the development at Blewitt's Falls, and it is estimated that as much more will be required to complete the project.

WINSTON-SALEM, N. C.—It is reported that negotiations are under way for the construction of a 75-mile electric railway from Winston to Leaksville. It is said that Clarence M. Smith & Company, of New York, N. Y., are interested in the enterprise.

DICKINSON, N. D.—The local telephone system owned by Hughes & Deiters, has been purchased by the North Dakota Telephone Company. The new owners, it is said, will erect a new exchange building, install a central battery system and erect overhead cables.

MILTON, N. D.—The question of calling an election to vote on the proposition of issuing bonds for the installation of a street-lighting system is under consideration.

BRYAN, OHIO.—The Fort Wayne & Toledo Electric Railway Company has been granted a franchise by the City Council to construct and operate a street railway over certain streets in this city. R. T. Bastress, of Harlan, Ind., is general manager.

CLEVELAND, OHIO.—The capital stock of the Cleveland Electric Illuminating Company has been increased from $6,500,000 to $10,000,000, of which the proceeds of the greater portion will be used for the construction of a new central power plant, to be located on the lake shore just west of East Seventieth Street. The building as planned will be 300 ft. x 720 ft., which will be built in sections; work on the first section will commence in the spring. The plant when completed will have an output of 250,000 hp. The equipment of the plant will include 18 large turbines.

DAYTON, OHIO.—Plans are being made by the Davis Sewing Machine Company, of Dayton, Ohio, to install additional shop equipment, including electrical apparatus.

GREENFIELD, OHIO.—The Greenfield Home Telephone Company has increased its capital stock from $30,000 to $40,000.

MANSFIELD, OHIO.—The New Method Stove Company is contemplating the installation of power-plant machinery with electric motors in its new factory now being built.

MIDDLETOWN, OHIO.—The Bardlow-Thomas Paper Company, of Middletown, Ohio, is contemplating the purchase of power-plant equipment aggregating 500 hp, consisting of boilers, Corliss engine, generator, motors and other apparatus.

NORTH BALTIMORE, OHIO.—It is reported that the local electric light plant owned and operated by A. G. Henry, of North Baltimore, will soon be taken over by Cleveland parties. Application will soon be made to the village for a new franchise as the present franchise will expire next year. The Council and the company have not yet been able to come to an agreement as to the length of the term of the franchise. The Council is willing to give only a 15-year franchise, while the company is holding out for 25 years.

EL RENO, OKLA.—The Commercial Club, it is reported, has accepted the proposal of the Leads Construction Company to build an interurban railway from El Reno to Anadarko and Chickasha, the city to furnish the right of way for 10 miles and subscribe a bonus of $40,000. It is said that an equal amount has been subscribed in Chickasha to the Caddo Development Company to build the railway, which is being promoted by farmers.

GUTHRIE, OKLA.—Contracts have been awarded by the State Board of Agriculture for heating and power plant at the State Agriculture and Mechanical College at Stillwater, Okla., as follows: For heating and power plant, to George Erichsen, of Ardmore, Okla., at $14,690, and to John Johnson, of Oklahoma City, Okla., for pipe tunnel for heating plant, for $6,700.

MEDFORD, OKLA.—It is reported that plans are being prepared for the construction of an electric-light plant in Medford, work on which will commence early in the spring. It is said that extensions will be made to the water-works system.

MUSKOGEE, OKLA.—Plans are being considered for the construction of an electric railway from Muskogee to Tulsa and Glen Pool, 66 miles in length. R. N. Eggleston, H. B. Spaulding, C. W. Turner, A. C. Trumbo and W. Robertson, all of Muskogee, Okla., are interested in the project.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating extensive improvements and extensions to its local system, which will involve an expenditure of $250,000. The capital stock of the company is reported to have been increased to $1,000,000.

HALSEY, ORE.—It is reported that plans are being considered for the construction of an electric light plant and enlarging the water works system. George Taylor, of Eugene, Ore., is interested in the enterprise.

JUNCTION CITY, ORE.—We are informed that the Northwest Corporation of Eugene, Ore., will extend its transmission line from Eugene to Junction City within a short time to supply electricity for the local system. The plant of the Howard Electric Light Company will be dismantled. B. F. Howard is manager of the Howard Electric Light Company.

LAIDLAW, ORE.—Negotiations have been closed whereby the two Awbrey Falls and the B. E. Nichols falls on the Deschutes River, near Laidlaw, have been purchased by H. H. Humphrey, of Kennewick, Wash., and Mrs. Carra Kirkham Swafford, of Laidlaw. It is understood that the new owners will develop the water power, which is estimated at between 40,000 and 50,000 hp. It is said that the consideration for the power site was $50,000. The promoters also purchased 1000 acres of land, which will be laid out with a townsite and orchard tracts.

MADRAS, ORE.—The Deschutes & Harney Telephone Company, recently organized, is planning to construct a telephone line from Rosland to Silver Lake, and to extend the Paulina line from Hardin to Burne, and erect a toll line from Redmond to Madras, via Culver. An exchange will be installed at Madras.

PENDLETON, ORE.—The Umatilla Railway & Electric Power Company is reported to have purchased the water power sites on the north fork of the John Day River, together with franchises, etc. It is said that work will be started on the project in the near future.

BLOOMSBURG, PA.—Announcement has been made of the completion of a merger combining six electric railways, twenty electric lighting plants and five gas plants in Berwick, Bloomsburg, Danville, Sunbury, Shamokin, Mount Carmel, Centralia, Ashland, Girardsville, Shenandoah, Mahanoy City and McAdoo, Pa., by E. R. Spensler, president of the Columbia Power, Light & Railways Company. The electric railways comprise 142 miles of trackage and extensions of 65 miles are planned, which will give a connection of electric railways from Wilkes-Barre to St. Claire, where the system will connect with electric railways of the J. G. White Company into Pottsville. The merger involves about $7,000,000.

CLAIRTON, PA.—The Peters Creek Street Railway Company has applied to the County Commissioners for a perpetual franchise over the county road in Jefferson County between Wilson and Clairton boroughs. The proposed railway will connect Glassport, Coal Valley, Wilson, Blair and Clairton. W. G. Wilson, of Dravosburg, is president.

LEMOYNE, PA.—The remodeling of the old power plant of the Valley Traction Company at Lemoyne is nearly completed. The station when completed will have an output of 2600 kw, and besides furnishing electricity for operating the railways of the company will be able to supply energy for lamps. When the plant is put into operation the company will discontinue the service from York Haven. The cost of the improvements to the plant and substations is estimated at $75,000. W. G. Davidson is purchasing agent.

MILLVALE, PA.—Estimates are being asked by W. Edgar Reed, Machesney Building, Pittsburgh, Pa., for an addition to the municipal electric-light and water plant in Millvale, which include the erection of a steel-frame and brick addition to power-house, 30 ft. x 40 ft.; 200-hp boiler, 180-hp steam engine, feed-water heater, alternating-current generator, arc-lighting system, piping and fittings.

MILTON, PA.—The plant and holdings of the Milton Electric Light & Power Company have been purchased by the United Light & Power Company. The new owners, it is said, will erect a new power plant on South Front Street, just below the Reading railroad bridge. New equipment will be installed and the town rewired. The United Light & Power Company has entered into a long-term contract with the Lewisburg, Milton & Watsontown Passenger Railway Company to furnish electricity to operate the railway. John F. Whittaker is president of the railway company.

PALMYRA, PA.—Daniel Weaver, of North Lebanon Township, has purchased from John H. Imoden a site, consisting of 138 acres, along the Berks and Dauphin Turnpike, just east of Palmyra, for $20,000. Mr. Weaver proposes to erect a large power plant on the site for the purpose of furnishing electricity for lamps and motors in Palmyra. A large machine shop will also be erected at the same place.

PHOENIXVILLE, PA.—The capital stock of the Phoenixville, Valley Forge & Stafford Street Railway Company has been increased from $60,000 to $350,000, and bonds to the amount of $600,000 will be issued for the purpose of constructing its proposed electric railway from Phoenixville to Stafford, 10 miles in length, and the Bridgeport and Norristown extensions. Franchises will soon be asked for in the boroughs of Phoenixville and Bridgeport. The power plant will be located at Valley Forge. The company will furnish electricity for lamps along the route of its railway. Thomas E. O'Connell, of West Chester, Pa., is president.

PITTSBURGH, PA.—Preparations are being made by the West Penn Railways Company for enlarging its power plant at Greene Junction. Contracts will soon be placed for the two 24,000-hp engines, which will increase the output of the plant to 48,000 hp. The cost of the improvements is estimated at $400,000. The company recently authorized an expenditure of $100,000 for steel cars, making a total expenditure of $500,000 this year. The Greene Junction power plant furnishes electricity for operating all the railways of the company from Brownsville and Masontown to McKeesport, and also for lamps in many of the Western Pennsylvania towns. J. W. Brown, of Connellsville, Pa., is superintendent of the transportation department.

PUNXSUTAWNEY, PA.—At the annual meeting of the Jefferson Electric Light, Heat & Power Company the stockholders voted to reconstruct the plant, the cost of which is estimated at about $75,000. It is understood that the plant will be moved to the outskirts of the town, and a 60-cycle, three-wire, 2200-volt system installed. The following named officers were elected: Dr. W. F. Beyer, president; W. C. Torrence, vice-president; Jacob L. Fisher, secretary, and W. W. Winslow, treasurer.

READING, PA.—The contract for lighting the streets of the city has been awarded to the Metropolitan Electric Company for a term of five years, under the terms of which the company is to furnish 700 or more arc lamps at $67.50 per lamp per year; 500 tungsten lamps at $19.20 each per year, and 500 Welsbach lamps at $25 per lamp per year.

ROYERSFORD, PA.—It is reported that the National Underwear Company, of Royersford, Pa., will soon be in the market for an engine-driven generator, boiler, feed pump and auxiliary apparatus for its new factory.

SPRING CITY, PA.—The Century Knitting Company, of Spring City, Pa., is contemplating the installation of complete power equipment, including boiler, engine, generator, feed pumps, switchboard, motors, etc.

TACONY, PA.—Preparations are being made by the Holmesburg, Tacony & Frankford Electric Railway Company to erect an addition to its boiler house, work on which will commence in April. It is proposed to install one 500-hp water tube boiler and two boiler feed plunger pumps. Henry Glazier is general superintendent.

TARENTUM, PA.—The Borough Council has granted the Tarentum, Brackenridge & Freeport Street Railway Company a perpetual franchise to construct an interurban electric railway in Allegheny County.

GREENVILLE, S. C.—Preparations are being made by the Southern Power Company for the construction of a large steam power plant for emergency purposes to supplement its various plants on the Catawba River. The cost of the new plant is estimated at $300,000, for which a site has been purchased. It is said that work will commence at once on construction of the plant. Contracts for machinery have already been placed.

ROCK HILL, S. C.—At an election to be held Feb. 24 the proposition to issue $35,000 bonds, the proceeds to be used for the construction of an electric-light plant, will be submitted to a vote.

SPARTANBURG, S. C.—The new extension of the Beaumont Manufacturing Company is nearing completion and it is expected to have it in operation by the last of February. The new building will be operated by electricity, while the other two mills are run by steam.

ABERDEEN, S. D.—A company has been organized in Aberdeen by local men for the purpose of installing a street railway system in this city during the coming summer. It is expected to build four miles of track at first. C. N. Herreid, of Aberdeen, S. D., is general manager of the company.

GREGORY, S. D.—It is reported that the company recently organized in Gregory will soon commence work on the construction of its proposed electric plant, which will furnish electricity to light the town and also for manufacturing and other purposes. The company is capitalized at $20,000.

ERWIN, TENN.—O. P. Heath & Company, of Charlotte, N. C., who have acquired the "Devil's Looking Glass" water-power, located near Erwin, it is said, will be in the market in the near future for hydraulic turbines and generators with a rating of 2000 kw. It is understood that one or more manufacturing plants will be erected near the power plant.

GALLATIN, TENN.—It is reported that H. H. Mayberry, president of the Nashville Interurban Railway Company, is contemplating the construction of an electric railway in Gallatin.

NASHVILLE, TENN.—The contract for installing the lighting fixtures in the new Davidson court house has been awarded to Herbrick & Lawrence, of Nashville, Tenn., electrical contractors.

ROGERSVILLE, TENN.—The Rogersville Electric Light & Power Company is contemplating asking for a franchise to supply electricity for street and commercial lighting and for motors in Rogersville. W. D. Harmon, J. W. McDonald Sons and others are interested in the project. The company has leased 250 hp from McDonald Brothers; more to be developed as required.

BEAUMONT, TEX.—An agreement has been reached between the City Council and the Beaumont Ice & Light Company, whereby the company is to supply electricity for street lighting at the rate of $70 per lamp per year, which is a reduction of $26 per lamp per year on the present contract. The city was contemplating the installation of a municipal electric plant.

BRYAN, TEX.—The City Council has granted a franchise to Mr. Cleaver and associates, of Houston, Tex., for the construction of a water works system and electric light plant in Bryan. Under the terms of the franchise work is to commence within six months from date of the franchise and must be completed and in operation within one year.

PARIS, TEX.—Preparations are being made by the Paris Light & Power Company for remodeling and improving its plant, which will involve an expenditure of $15,000.

SAN BENITO, TEX.—The San Benito Land & Water Company is reported to have awarded a contract to the Fairbanks-Morse Company, of Chicago, Ill., for the installation of a combined water and electric-light plant, to cost $25,000.

SAN MARCOS, TEX.—The Acme Manufacturing Company is reported to be in the market for a generator and engine with sufficient output to supply 100 lamps.

WOODWARD, TEX.—Messrs. Hust & Brundage and J. S. Sweet, of San Antonio, Tex., have purchased the town of Woodward (comprising 640 acres) and contemplate further developments, which will involve an expenditure of $225,000 and include the construction of a railroad through the town, electric-light and power plant, hotel, etc.

ABINGDON, VA.—Preparations are being made by the Virginia & Tennessee Telephone Company to establish exchanges in Glade Springs and Abingdon and to erect a long-distance telephone line between Bristol and Chilbowie, Va., a distance of 25 miles. N. C. Watts is president. The main office is located at Roanoke, Va.

BEDFORD CITY, VA.—Negotiations have been completed for the purchase of the Snowden dam on the James River from the Amherst Pulp Manufacturing Company by W. R. Abbott, Jr., for the town of Bedford City, the consideration being $32,500. Work will soon commence on the hydroelectric development at the dam and municipal electric plant, for which bonds to the amount of $100,000 have been voted. It is estimated that 1000 hp can be developed.

BRISTOL, VA.—The City Council is considering the question of installng a plant for electric sterilization of the city water supply. A proposition has been submitted by F. P. Lewenstein, of Atlanta, Ga., representing a firm which establishes such plants.

NEWPORT NEWS, VA.—The question of establishing a municipal electric-light plant in Newport News is under consideration. Maryus Jones is Mayor.

RICHMOND, VA.—The Virginia Railway & Power Company has entered into a contract with the American Locomotive Works to furnish the last-named company with 1000 hp for a term of five years at the Richmond branch. It is said the managers of the locomotive works are planning to increase the use of electrically driven machinery in its plants. Contracts have been awarded by the Virginia Railway & Power Company to the Westinghouse Electric & Manufacturing Company, of Pittsburgh,

Pa., for a 6000-hp turbo-generator set to be installed at its Twelfth Street power house.

WAYNESBORO, VA.—Plans are being considered by the Waynesboro Electric Light & Power Company for increasing the output of its power plant.

ABERDEEN, WASH.—Application has been made to the County Commissioners by the Grays Harbor Interurban Company for a new 50-year franchise to construct and operate a system of interurban railways through Chehalis County, connecting Montesano and Aberdeen. W. H. Abel is attorney for the company.

CHEHALIS, WASH.—The Chehalis Fire Door Company is reported to be contemplating the installation of a 225-hp power plant, the equipment of which will include a belted dynamo and several motors.

TACOMA, WASH.—It is said that the city intends to make permanent the street lighting system put in operation last summer. Iron arches to span the principal streets will be designed by George Gove, architect.

TENINO, WASH.—The Tenino Light, Power & Water Company has applied to the County Commissioners for a franchise over the county roads. The franchise asked for begins at the county line north of Centralia and extends in a southerly direction to Chehalis.

PASCO, WASH.—The Columbia River Orchard Company has awarded a contract to Kilbourne & Clark, of Seattle, Wash., for the construction of a pumping station to irrigate a 15,000-acre tract near Wahluke. The contract calls for an electrically driven pumping plant consisting of four units having a capacity of 10,000 gal. per minute each.

CHARLESTOWN, W. VA.—The contract for lighting the town for a term of three years has been awarded to the Charlestown Light & Power Company at $2,500 per year.

HUNTINGDON, WIS.—Contracts have been awarded by O. W. Mosher for equipment of an electric-power transmission plant at Huntingdon on Apple River, as follows: The General Electric Company, of Schenectady, N. Y., for generator; twin water wheels with a rating of 8000 hp to the James Leffel Company, of Springfield, Ohio. Electricity generated at the plant will be transmitted to New Richmond, Wis.

LA CROSSE, WIS.—Plans are being prepared by the La Crosse Water Power Company for the construction of a large dam across the mouth of Rock Creek at the East Fork of Black River, work on which will commence as soon as the weather will permit. W. J. Ferris is president of the company.

NEKOOSA, WIS.—The installation of a 1000-hp water wheel-driven generator and a line of heavy alternating-current motors, of the squirrel-cage type, up to 200 hp in size, has been decided upon by the Nekoosa-Edwards Paper Company, of Nekoosa, Wis.

OCONTO, WIS.—George H. Holt is reported to be contemplating the installation of a 100-hp alternating-current generator (belted), with exciter, switchboard, etc., in his plant to supply electricity for lamps and motors.

WAUSAU, WIS.—The Wausau Paper Mills Company is contemplating remodeling its plant, which will include the installation of heavy machinery and power equipment.

VICTORIA, B. C., CAN.—Application has been made to the chief water commissioner by Michael King to appropriate 100,000 in. of water, to be taken from the Campbell River at the falls, where it is estimated that over 30,000 hp could be developed.

WINNIPEG, MAN., CAN.—Bids will be received until Feb. 15 by the chairman of the Board of Control, Winnipeg, Can., for the construction of the power terminal station in Winnipeg. M. Peterson is secretary.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has placed orders with the Babcock & Wilcox Company, of Montreal, Que., Can., for boilers aggregating 3000 hp, which will be installed in its steam plant on the Assinaboine River, in Winnipeg, at a cost of about $35,000.

WINNIPEG, MAN., CAN.—The court has handed down a decision that the Winnipeg Electric Railway Company cannot legally transmit electricity from its hydroelectric power plant at Lac du Bonnet, on the Winnipeg River, 60 miles distant, into this city for commercial purposes. Action was brought by the city against the railway company in 1906, arising out of the distribution of electrical energy generated outside of the city limits, which the city claimed was in violation of the company's franchise.

FORT WILLIAM, ONT., CAN.—Rapid progress is being made by the Kakabeka Falls & Mount McKay Electric Railway Company on the construction of its rural lines. It is expected to have the railway to Kakabeka Falls, 18 miles distant, finished during the coming summer. As soon as warranted the railway will be extended so as to form a belt line.

FORT WILLIAM, ONT., CAN.—We are informed that the Kaministiquia Power Company has under construction over 10 miles of transmission lines to supply the demands of its new customers. The present plant is laid out for 50,000 hp; the present output is 15,000 hp. It is expected that another of 10,000-hp unit will be installed in the near future to meet the rapidly increasing demands. W. L. Bird is secretary and manager.

FORT WILLIAM, ONT., CAN.—The Kaministiquia Power Company is furnishing electricity to operate the Western Terminal elevator, which has a capacity of 1,000,000 bushels and requires over 600 hp. The Ogilvie Flour Mills Company has recently installed a new 1,000,000-bushel elevator and increased the output of its mill by 25 per cent. The mill is equipped for electrical operation, electricty for which is supplied by the Kaministiquia Power Company. About 2000 hp is required.

FORT WILLIAM, ONT., CAN.—The Allis-Chalmers-Bullock Company has completed the installation of a 1000-hp motor-generating set in the power station of the Kaministiquia Power Company at Fort William to supply electricity for the street railway between Port Arthur and Fort William, which is owned jointly by the two cities. Four new cars have been received and eight more have been ordered. Double-tracking of the system throughout will be completed during the coming summer. N. C. Pilcher is general manager of the street railway.

PORT ARTHUR, ONT., CAN.—A large dam which is now under construction at Dog Lake will assure the water supply of the Kaministiquia Power Commission to its full development. The dam is being constructed by the Hydro-Electric Power Commission, which recently contracted with the Kaministiquia Power Company for all its power for use within a radius of 40 miles. The cost of the dam is estimated at $60,000.

PORT ARTHUR, ONT., CAN.—The city of Port Arthur has closed a contract with the Hydro-Electric Power Commission for from 5000 to 10,000 hp. The power is to be supplied from the plant of the Kaministiquia Power Company at Kakabeka Falls. Work will commence at once on the construction of the transmission lines and substation. W. L. Bird, of Fort William, Ont., is secretary and manager of the Kaministiquia Power Company.

MELVILLE, SASK, CAN.—It is reported that Cushing & Weir have been granted a 10-year franchise to construct and operate an electric light and power plant in Melville, to cost approximately $30,000.

BATOPILAS, MEX.—Plans are being made by the Batopilas Mining Company for the construction of a hydroelectric power plant in the Batopilas district, State of Chihuahua, for the purpose of providing electricity for operating its mines and reduction mill.

CHIHUAHUA, MEX.—The Mayo River Power & Land Company has taken over power concessions on the Mayo River and proposes to construct a series of dams for the development of power, work on which will begin about April 1. The company is capitalized at $5,000,000. W. O. Temple is secretary. Headquarters of the company are located in Denver, Col.

MEXICO CITY, MEX.—The site for the proposed dam to be built by the Federal Government across the Nazas River in Northern Mexico at an estimated cost of $12,000,000 (Mexican money) has been selected and surveys and plans are in the hands of the State officials for approval. The contract for construction of the dam has been awarded to S. Pierson & Son. While the primary object of the dam is for water storage for irrigation purposes, it is announced that the water will also be utilized to generate electrical power, which will be transmitted to the cities of Torreon, Durango, Lerdo, Gomez, Palacio, Mapimi, San Pedro and other smaller cities and towns.

Company Elections.

WESTFIELD, MASS.—At the annual meeting of the Westfield Power Company, held recently, the following-named officers were elected: M. B. Whitney, president; Sumner B. Campbell, treasurer and clerk, and George C. Dunbar, superintendent.

TRAVERSE CITY, MICH.—At a meeting of the Manistee River Power Company, held recently, Colin P. Campbell, of Grand Rapids, Mich., was elected president, and F. D. Campau, of Grand Rapids, Mich., secretary.

TORONTO, ONT., CAN.—At a meeting of the directors of the Toronto Electric Light Company, held Jan. 13, J. J. Wright was elected second vice-president and consulting engineer; Hubert H. Macrea, general manager; W. A. Martin, assistant manager; R. F. Pack, secretary and comptroller, and M. Pellatt, treasurer. Sir Henry Pellatt is president of the company, and W. D. Mathews, first vice-president.

New Industrial Companies.

THE AMERICAN CABLE & MANUFACTURING COMPANY, of Stanberry, Mo., has been incorporated with a capital stock of $15,000 to establish a plant to manufacture copper cable, lightning rods and copper-cable lightning conductors for grounding field fences. J. C. Etz is president; O. H. De Moss, vice-president, and W. S. Hardin, secretary and treasurer.

THE ARGUS BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $175,000 by A. P. Cram, B. Irwin and C. T. Leonard, of New York, N. Y. The company proposes to do a general electrical engineering business and deal in electrical supplies.

THE BARBOUR PLUMBING, HEATING & ELECTRIC COMPANY, of Birmingham, Ala., has been chartered with a capital stock of $25,000. The officers are: B. C. Rickman, president; Charles B. Baritz, vice-president; J. A. Sellman, secretary and treasurer.

BASS BROTHERS, of New York, N. Y., have filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing and dealing in hardware, tools and electrical devices. The incorporators are: Rudolf Bass, Seymour Sylvester and Harry Greenberg, of New York, N. Y.

THE BULLOCK SAFETY APPLIANCE COMPANY, of Poughkeepsie, N. Y., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing and dealing in electrical supplies, particularly electrical alarm and signal apparatus. The incorporators are: P. H. Troy, of Poughkeepsie, N. Y.; H. F. White, of New York, N. Y., and J. S. McClellan, of Albany, N. Y.

DICKSON & TURNBULL, of New York, N. Y., have been incorporated by Alexander Dickson, George Turnbull and Alexander Dickson, Jr., all of New York, N. Y. The company is capitalized at $40,000 and proposes to do general contracting and construction work.

THE HUCKNALL CONSTRUCTION COMPANY, of Albion, N. Y., has been chartered with a capital stock of $10,000 for the purpose of doing a general contracting and construction business. The incorporators are: Thomas Hucknall, Mary Hucknall, of Albion, N. Y., and Albert J. Harradine, of Adams Basin, N. Y.

THE HYDROCARBON BURNER & MANUFACTURING COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $300,000 to manufacture and sell machinery. The incorporators are: W. H. Brownell, F. H. Vedder and E. S. Lewis, of Hoboken, N. J.

THE LITHARGE BATTERY & SUPPLY COMPANY, of New York, N. Y., has been incorporated by Frank J. Schalow, of Brooklyn, N. Y.; Baltraus S. Yankaus, of New York, N. Y., and John W. Saukaltis, of Brooklyn, N. Y. The company is capitalized at $5,025 and proposes to manufacture electric batteries and electrical supplies.

THE MODEL ELECTRIC COMPANY, of Malvern, Ohio, has been incorporated with a capital stock of $20,000 by L. Conrad, H. C. Long, H. W. Pennock, A. B. Bucklin and W. F. Weaver.

THE MOUNTAIN LAKES, INC., has filed articles of incorporation for the purpose of doing a general contracting and mechanical engineering business. The company is capitalized at $200,000, and incorporators are: J. R. Simpson, J. W. Underhill and W. J. Doyle, Jr., of Boonton, N. J.

THE NATIONAL ELECTRIC SPECIALTY COMPANY, of Toledo, Ohio, has been chartered with a capital stock of $50,000 for the purpose of manufacturing lightning arresters and other specialties used in telephone work. The lightning arrester is the invention of Louis D. Chapman, of Toledo, Ohio. The company will either build or purchase a factory in Toledo. The incorporators are: C. A. Atwell, Charles S. Northrup, Paul Chapman, C. J. Nolan and Louis D. Chapman. S. O. Richardson, president of the Libby Glass Company, will be president of the company.

THE NEW YORK VACUUM TUBE SERVICE, of New York, N. Y., has been incorporated to operate pneumatic and vacuum tubes for transmission and delivery of goods. The company is capitalized at $25,000 and the incorporators are: D. E. Johnson, W. R. Watson and A. W. Britton, of New York, N. Y.

THE PETRY ENGINEERING COMPANY, of Indianapolis, Ind., has been incorporated by Ambrose Petry, John T. Bacon, J. P. Beaty, H. L. Olds and M. O. Straight. The company proposes to do a general engineering and construction business, making a specialty of electric railroads and electric plants.

THE PUBLIC AUTOMOBILE SERVICE CORPORATION, of Newark, N. J., has filed articles of incorporation with a capital stock of $2,500,000 for the purpose of operating automobiles equipped with taximeters and other appliances. The incorporators are: W. P. Buchler, E. D. Kahn, of New York, N. Y., and C. E. S. Thorn, of Newark, N. J.

THE ROGERS-BROWN IRON COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $5,000,000 for the purpose of manufacturing articles from iron, steel, copper, etc., by William A. Rogers, Stephen M. Clement and Charles W. Goodyear, all of Buffalo, N. Y.

THE SUBURBAN TRANSIT CONSTRUCTION COMPANY, of Jersey City, N. J., has been incorporated by W. S. Sawyer, of Bayonne, N. J.; H. T. Randall, of East Orange, N. J., and W. L. Hunt, of New York, N. Y The company is capitalized at $25,000 and propqses to do a general contracting business

THE VITA ELECTRIC SIGN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000 by E. J. Prindle, of East Orange, N. J.; A. Stewart, of Brooklyn, N. Y., and C. B. Hobbs, of Greta River, N. Y. The company is capitalized at $200,000 and proposes to manufacture and deal in electric signs.

THE WINDSOR MOTOR CAR COMPANY, of Buffalo, N. Y., has been chartered by Henry M. Colgrove, Joseph Schmid, Jr., and Joseph Buettner, all of Buffalo, N. Y. The company proposes to manufacture motor vehicles, motors, engines, etc.

New Incorporations.

VAN BUREN, ARK.—The Fort Smith, Van Buren & Interurban Light & Traction Company is reported to have been organized by the citizens of Sebastian and Crawford counties for the purpose of constructing an electric railway through Crawford, Franklin, Johnson, Madison, Newton, Boone and Searcy counties. A preliminary survey has been made and the rights-of-way secured from Van Buren to Mulberry. The company is capitalized at $10,000, and the officers are: W. F. Keller, president; L. W. Burgett, vice-president; T. A. Bayley, secretary; S. A. Pernot, treasurer, and T. A. Bailey, engineer.

SAN FRANCISCO, CAL.—The Hawkins Electric Company has been incorporated with a capital stock of $20,000 by C. W. Klipsch, D. L. Anthony and O. T. Barber.

DOVER, DEL.—Articles of incorporation have been filed for the Peninsula Electric Company by E. O. Walton, of Iron Hill, Md.; T. Gibb and J. W. Hussey, of Philadelphia, Pa. The company is capitalized at $50,000.

WILMINGTON, DEL.—The Wonder Electric & Power Company has filed articles of incorporation with a capital stock of $500,000. The incorporators are: C. A. Higbee, J. S. Austin, of Philadelphia, Pa., and J. H. Whiteman, of Wilmington, Del.

SHELLMAN, GA.—Articles of incorporation have been filed for the Shellman Telephone Company with a capital stock of $5,000 by W. T. Jay, T. R. Arthur, C. W. Martin, W. T. Jay & Company, H. O. Crittenden and others for the purpose of establishing a telephone system in Shellman.

WAYCROSS, GA.—The Ware County Light & Power Company has been incorporated with a capital stock of $250,000 by Burdette Loomis and Burdette Loomis, Jr., of Hartford, Conn.; P. R. Bomeisler, of East Orange, N. J.; Leon A. Wilson, W. W. Lambdin and John A. Bennett, of Waycross, Ga. The company will take over the plant and holdings of the Waycross Electric Light & Power Company and make improvements to the same.

CHAMPAIGN, ILL.—Articles of incorporation have been filed for the St. Louis, Springfield & Peoria Railroad Company with a capital stock of $5,000,000. The incorporators are: George M. Mattis, W. P. Carnahan, Charles Zilly, R. E. Bramble and Charles E. Cox, all of Champaign, Ill.

CHICAGO, ILL.—The Hammond, Chicago Heights & Southern Traction Company has filed articles of incorporation with the Secretary of State for the purpose of constructing an electric railway from a point on the State line near Hammond, Ind., to Chicago Heights and thence to Stanne, in Kankakee County. The company is capitalized at $500,000 and the incorporators are: William S. Reed, Andrew Ward, Joseph Orr and Edward R. Davis, all of Chicago, Ill., and Alfred Van Steenburg, of Lansing, Ill.

CHICAGO, ILL.—The Chicago, Bloomington & Peoria Railway Company has been chartered with a capital stock of $25,000 for the purpose of constructing an electric railway from Chicago to Bloomington and Peoria. The directors are: Jerome J. Danforth, Charles S. Sollars, Averne A. Hyde and Frank M. Capp, all of Chicago, Ill., and Virginius L. Garnett, of Highland Park, Ill.

ELDORADO, ILL.—Articles of incorporation have been filed with the Secretary of State for the Egyptian Traction Company by C. C. Leggett, of Winchester, Ind.; John W. Murphy and S. W. Latham, of Eldorado, Ill.; John D. Stayron, of Texas City, Ill., and G. E. K. Hixon, of Chicago, Ill. The company is capitalized at $5,000 and proposes to construct an electric railway from Murphysboro through Williamson, Saline, Gallatin and White counties to the Wabash River.

INDIANAPOLIS, IND.—The Indiana Power Company has been incorporated with a capital stock of $25,000 to establish a power plant.

SHOALS, IND.—Articles of incorporation have been filed for the Shoals Power Company by Henry A. Mansfield, S. A. Feschen and F. M. Bachman. The company is capitalized at $50,000 and proposes to construct and operate a plant to generate electricity for light, heat and power purposes.

HAZLETON, IA.—The Hazleton Farmers' Telephone Company has been chartered with a capital stock of $10,000 by C. I. Nelson, D. N. King, John D. Allen, E. J. Short and others.

BELLEVILLE, KAN.—The Motor Grand Traction Company has been chartered to construct a railway, to be operated by gasoline or electricity, from Belleville via Concordia, Minneapolis, Salina, Canton and Newton to Wichita, a distance of about 150 miles. The company is capitalized at $1,000,000, and the incorporators are: E. S. Alnutt, E. N. Van Hosen, G. L. Litel and Roy S. Johnson, of Belleville, Kan., and W. L. Hope, of Fairbury.

AUGUSTA, MAINE.—The Central Mexico Light & Power Company has been organized with a capital stock of $2,750,000 for the purpose of generating and distributing gas, electricity and steam. E. M. Leavitt, of Winthrop, Maine, is president.

CASTINE, MAINE.—Articles of incorporation have been filed for the Castine Light, Power & Heating Company with a capital stock of $10,000. The company proposes to furnish electricity and gas in Castine, Brooksville and Penobscot. William A. Walker is president, and William G. Sargent is treasurer of the company.

LAKE CITY, MINN.—The Lake Pepin Telephone Company has been incorporated with a capital stock of $25,000 by W. G. Ball, G. M. Delle, G. H. Hammond and J. C. Brinkman.

KALISPELL, MONT.—Articles of incorporation have been filed for the Whitefish & Polson Electric Railway Company by G. H. Adams, J. H. Stevens, Joseph Edge, D. Ledgerwood, O. P. Mosby and Peter Nilson. The company is capitalized at $200,000 and proposes to construct an electric railway from Kalispell northward to Whitefish and southward through Somers to Polson, on Flathead Lake.

TOWNSEND, MONT.—The Townsend Water Power & Electric Company has been formed with a capital stock of $40,000 for the purpose of

Mr. James Campbell, who was made a member of the board to succeed Mr. C. W. Wetmore, was elected first vice-president. Mr. Breckenridge Jones was chosen second vice-president to succeed Mr. Julius S. Walsh, and Mr. Festus J. Wade was chosen third vice-president to succeed Mr. Jones. Mr. Herman Spoehrer was re-elected secretary. The executive committee now is: Messrs. James Campbell, J. H. Drabelle, Festus J. Wade and Alton S. Miller. The presidency of the company has been vacant for several months, since Mr. J. I. Beggs retired.

Trade Publications.

TRANSFORMERS OF THE POLE-BASE TYPE for ornamental tungsten street illumination are outlined in leaflets being distributed by the American Transformer Company, Newark, N. J.

MAGNETO TELEPHONES.—The Western Electric Company is distributing a booklet in the form of a post card showing illustrations of all parts of its No. 1317 type magneto telephone set.

CONDUIT.—Rustproof, non-corrosive conduit, to which has been applied the trade name "Sherarduct," is outlined in a mailing folder issued by the National Metal Molding Company, Pittsburgh, Pa.

TOOLS.—Edition G of the illustrated catalog of the Garvin Machine Company, New York, N. Y., deals with hand lathes, cutter grinders, milling machine tools, screw machine tools and various attachments.

ELEVATOR BUCKETS.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued booklet No. 34 dealing with elevator buckets particularly designed for handling coal, broken stone, sand and gravel.

STREET LAMP POLES for arc and incandescent lighting units are well discussed in an illustrated booklet entitled "Off the Beaten Track," published by the Elmer P. Morris Company, 90 West Street, New York.

ELECTRIC MOTOR TRUCKS.—The Packard Motor Car Company, Detroit, Mich., is distributing an illustrated mailing card calling attention to its three-ton trucks, which have proved excellent for its own delivery service.

BRUSHES.—Bronze-woven wire brushes and pure copper gauze brushes, for use with generators and motors, are briefly described and illustrated in the folder issued by the Ohio Electric Specialty Manufacturing Company, Troy, Ohio.

OUTLETS.—The Bossert Electric Construction Company, Utica, N. Y., has issued an illustrated poster devoted to drawn-steel outlets and switch boxes. These devices are of the unbreakable type and are particularly adapted for fireproof installation.

STORAGE BATTERIES.—Bulletin No. 108 of the United States Light & Heating Company, 30 Church Street, New York, contains complete instructions for the care and operation of the National batteries for gas engine ignition and for automobile and motor-boat lighting.

AUTOMOBILE LAMPS.—Electric lighting installations particularly adapted for use with automobiles are treated in a publication of the Electric Storage Battery Company, Philadelphia, Pa. This company has also issued a special instruction book for the users of storage batteries.

PANEL BOARDS AND CABINETS.—The construction of panel boards and cabinets, of wood and steel, built by the Crouse-Hinds Company, Syracuse, N. Y., is described by a series of detail illustrations which make up a booklet on this subject just issued by the manufacturer.

ELECTRICAL MACHINERY.—The listing of the large stock of electrical and steam machinery, power-house equipment, cars, etc., of MacGovern, Archer & Company, 114 Liberty Street, New York City, is again brought to date in their monthly stock catalog for February, just issued.

WIRE CABLE CONVEYORS.—Booklet No. 33 of the Jeffrey Manufacturing Company, Columbus, Ohio, covers wire cable conveyors designed for medium and long-distance haulage. Three conveyors have found extensive application in the handling of a wide variety of materials.

MECHANICS' TOOLS.—The Hargrave line of mechanics' tools, including drills, pliers, clamps, screw-drivers, wrenches and other implements used by electrical workmen, is listed and illustrated in a new catalog issued by the manufacturer, the Cincinnati Tool Company, Cincinnati, Ohio.

DRY KILNS.—The American Blower Company, Detroit, Mich., has issued as its illustrated sectional catalog No. 265 a fully illustrated description of moist air dry kilns, arranged either for natural circulation or for forced circulation. These kilns are intended particularly for drying timber products.

CIRCUIT BOXES.—Agutter Griswold Company, Seattle, Wash., has issued Bulletin No. 104, describing its line of sheet steel boxes for switches and cutouts. The bulletin illustrates a number of new sizes, some of the smaller of which are made up with switches and cutouts ready for insallation.

BALL BEARINGS.—The International Engineering Company, 1779 Broadway, New York, has issued an artistic catalog giving complete technical descriptions of ball bearings, and the uses to which they may be put. The catalog contains, also, complete data and price lists relating to various styles of bearings.

EXHAUST FANS.—The American Blower Company, Detroit, Mich., has isued bulletin No. 271, giving much data relating to cast-iron exhaust fans designed to deliver from 386 to 6350 cu. ft. per minute. Fans for delivering from 1300 to 18,000 cu. ft. per minute are discussed in bulletin No. 272 of the same company.

ASBESTOS WOOD.—Transite asbestos wood, which has the same physical characteristics as ordinary wood, except that it is harder and takes a higher polish, is described in a folder issued by the H. W. Johns-Manville Company, 100 William Street, New York. This wood is particularly useful for fireproof construction.

TELEPHONE CABLE MANUFACTURE.—"How Lead-Covered Cable is Made in the World's Largest and Best-Equipped Cable Plant" is the title of a booklet of illustration pages issued by the Western Electric Company, describing its cable factory at Hawthorne, Ill., which has a capacity for producing 200,000,000 conductor-feet per week.

ELECTRICAL MACHINERY.—The January catalog of Rossiter, MacGovern & Company, 90 West Street, New York, lists and describes the extensive stock of new and used electrical machinery, generators, motors, converters, transformers, controllers, arc lamps, instruments, etc., on hand at the company's warehouses in West Side Avenue, Jersey City, N. J.

VARIABLE-SPEED SINGLE-PHASE MOTORS.—The Kimble Electric Company, 1121 Washington Boulevard, Chicago, Ill., has issued a catalog giving much information concerning its variable-speed single-phase motors. These motors are of the commutator type, the speed variations being obtained by shifting the brushes around the commutator.

TELEPHONES.—The Western Electric Company is circulating an illustrated booklet, designated as No. 1106, covering metal-set automatic intercommunicating telephones for business and residence service. Descriptions are given of the cable terminal, connecting block, batteries and battery boxes used in connection with these sets. The sets include metal wall types, both flush and non-flush, and desk sets for office use.

AIR-BRAKE EQUIPMENT.—The General Electric Company in Bulletin No. 4703-A describes its variable-release air-brake equipment, which is said to eliminate the defects usually found in the standard automatic air-brake equipment for electric service. With the variable-release equipment it is possible to handle a long train with nearly the same facility as single cars can be handled with the straight air-brake system.

FUSES.—The new catalog covering Union fuse protection material issued by the Chicago Fuse Wire & Manufacturing Company, 215 South Clinton Street, Chicago, describes in detail, with the aid of dimensioned sketches, the various types of enclosed fuses, of both the new and old codes, as well as new-code fuse blocks up to 5000 volts. The Union line of fuse material also includes the older types of open-link, wire and strip fuses.

VENTILATING FANS.—Bulletin No. 264 of the American Blower Company, Detroit, Mich., gives a brief outline of cone fans, and contains much data relating to the practical operation of these fans. Bulletin No. 263 of the same company relates to steel plate fans, which are intended for the movement of large volumes of air. The latter fans are regularly built either full or three-quarter housed, and are intended for exhaust service.

ELECTRICAL INSTRUMENTS.—Foote, Pierson & Company, 160 Duane Street, New York, have issued a new catalog of electrical measuring and scientific instruments, illustrating and describing the complete line of laboratory apparatus of their manufacture. These include standard resistances and condensers, galvanometers, bridges, test-sets, ohmmeters, standard cells, dynamometers, induction coils and Roentgen-ray apparatus.

PUMPS.—Bulletin W-175, issued by Henry R. Worthington, 115 Broadway, New York, deals with turbine pumps for high-head service. These pumps are especially well adapted for driving by means of high-speed electric motors. Bulletin No. W-176 of the same company is devoted to centrifugal pumps for low-head service. Data are given on pumps for delivering from 50 to 6000 gallons per minute, against heads of from 10 to 100 ft.

STEEL PLATE FANS.—The Green Fuel Economizer Company, Mattewan, N. Y., has issued a 56-page pamphlet devoted to steel-plate fans for all purposes. Besides giving tables of pressure, velocity, horse-power, etc., necessary for moving air, it also goes into the discussion of efficiency and cost of operation, as compared to the first cost of fans; takes up the various methods of construction and balancing and points out the necessity of having each fan suited to the particular requirements of an installation.

CARBON BRUSHES.—The numerous forms of carbon brushes manufactured by the Le Carbone Company, of France, for which W. J. Jeandron, 20 Vesey Street, New York, is sales agent for the United States, are described and illustrated in a 40-page bulletin newly issued by the American distributer. The booklet includes a brief history of the use of carbon-collecting brushes and gives complete data, dimensions, contact resistances, etc., of the many types made by the Le Carbone Company for generator and railway and stationary-motor use.

STEAM ENGINE CRANK EFFORTS.—A pamphlet entitled "The Arrangement of Engine Cylinders to Produce Uniform Torque" has been issued by the American Engine Company, of Bound Brook, N. J. Typical indicator cards taken from the American Ball angle compound engine, from which a crank-effort diagram is derived, show that this type of engine produces a torque which is nearly as uniform as that given by steam turbines, while the steam consumption is considerably less than that of turbines. The booklet also contains a discussion of the crank-effort diagram.

supplying electricity to neighboring towns and mines. Work has already commenced on the construction of a dam. C. S. Muffly, J. A. Matthews, E. H. Goodman, A. A. Stafford and S. Wisemiller are interested in the enterprise.

HARVARD, NEB.—The Harvard Electric Company has filed articles of incorporation with a capital stock of $25,000. The incorporators are: O. J. Shaw, A. W. Person, N. E. Pearson, Charles P. Croft and others.

MISSION CITY, NEB.—Articles of incorporation have been filed for the New Westminster-Mission Light & Power Company. The company is capitalized at $50,000 and proposes to furnish electricity in Mission City.

ORLEANS, NEB.—Articles of incorporation have been filed for the Orleans Electric Light Company with a capital stock of $10,000 by P. W. Shea, S. S. Kirtland and W. P. Price.

CAMDEN, N. J.—The Penn Central Light & Power Company, of New Jersey, has been chartered by F. R. Hansell, W. F. Eidell and J. A. MacPeak, of Camden, N. J., to act as financiers, promoters, contractors, merchants, etc. The company is capitalized at $3,000,000.

CAMDEN, N. J.—Articles of incorporation have been filed for the Camden Light & Power Company by R. S. Johnson, I. D. West and J. C. Davies, of Camden, N. J. The company is capitalized at $80,000 and proposes to construct and operate an incandescent lighting plant.

JERSEY CITY, N. J.—The Equador Long Distance Telephone Company has been incorporated with a capital stock of $50,000 by G. E. Fox, F. A. Branda and A. C. Watson, of New York, N. Y. The company is capitalized at $50,000 and proposes to carry on a telegraph and telephone business.

TAOS, N. M.—The Rio Lucero Power Company has been incorporated with a capital stock of $100,000 by Malaquias Martinez, Bert G. Phillips and Parker N. Black, who has been appointed agent for New Mexico.

GASTONIA, N. C.—The Piedmont Traction Company has been chartered to construct an electric railway in Gastonia and which is to be extended to Mt. Holly, 15 miles distant. Preliminary work has commenced on the railway in Gastonia, and it is expected that contracts will soon be awarded for grading the road to Mt. Holly in the near future. S. Lee, of Charlotte, N. C., vice-president of the Southern Power Company, and C. E. Hutchinson, of Mt. Holly, are interested in the enterprise.

SMITH, N. C.—The Farmers' Rural Telephone Company has been chartered with a capital stock of $6,000 by D. V. Walker, W. G. McLean and others.

WHITEVILLE, N. C.—The Whiteville Light & Power Company has been organized by I. J. Carrington, of Pennsylvania; J. R. Williamson, of Whiteville, N. C., and J. J. Hufford. Under the terms of the franchise granted to the company by the town, work must commence on the construction of its plant in April and be completed by the end of the year.

COLUMBUS, OHIO.—Articles of incorporation have been filed for the Fostoria, Napoleon & Defiance Railway Company by W. S. Reece, R. T. Betts, George Schrock, Charles Aten and Charles A. Bliss. The company is capitalized at $100,000 and proposes to construct an electric railway through Seneca, Wood, Henry, Hancock and Defiance counties.

WOODVILLE, ORE.—The Evans Creek Telephone Company has been organized by the citizens of Woodville and property owners along Evans Creek for the purpose of constructing a telephone line up Evans, Pleasant and Wards Creeks, a distance of about 25 miles.

RENOVO, PA.—The Renovo & Gleasonton Street Railway Company has been incorporated with a capital stock of $30,000 to construct an electric railway from Renovo to Gleasonton, a distance of five miles. The directors are: R. V. Rogers, W. B. Reilly, of Renovo, Pa.; J. H. Crissman and T. W. Gleason.

ORANGEBURG, S. C.—The Orangeburg & Bowman Telephone Company has been organized by W. H. Dukes and J. L. Dukes for the purpose of establishing a telephone system between Orangeburg and Bowman, with a change in the last-named place.

ROCK HILL, S. C.—The Carolina Traction Company has been chartered with a capital stock of $150,000 for the purpose of constructing an electric railway connecting Rock Hill, Chester, Fort Mill and Charlotte, which later will be extended to Yorkville and other towns within a radius of 30 miles from Rock Hill. The total length of the railway will be about 150 miles. The company is understood to be controlled by interests connected with the Southern Power Company. J. M. Cherry, of Rock Hill, is president.

CENTRALIA, WASH.—Articles of incorporation have been filed for the Centralia-Chehalis Water & Power Company by John E. Heasty, L. W. Goodrich, E. S. Price, F. S. Blatner and Clayton W. Quale. The company is capitalized at $250,000.

Legal.

THE SIERRA & SAN FRANCISCO POWER COMPANY BRINGS SUIT FOR RIGHT-OF-WAY.—The Sierra & San Francisco Power Company, of Sonora, Cal., has filed suit in the superior court of Santa Clara County, at San Jose, Cal., against the Spring Valley Water Company to obtain a right-of-way for a transmission line in the vicinity of Dumbarton Point. The Sierra company has secured rights-of-way for 50-ft. steel poles at a distance of 800 ft. apart through Tuolumne, Calveras, Stanislaus, San Joaquin, Alameda, Santa Clara, San Mateo and San Francisco counties. The only portion not yet secured by the company is a small strip of land near Dumbarton Point owned by the Spring Valley Water Company and subsidiary concerns. According to the complaint filed, the Sierra company has offered to purchase at a fair price the right-of-way, but the Spring Valley company, being a rival concern, has refused to sell.

Personal.

MR. E. K. MORSE has been elected president of the Engineers' Society of Western Pennsylvania.

MR. CHAS. E. WADDELL has established offices for general engineering practice in Asheville, N. C.

MR. F. C. FINKLE, consulting engineer, Los Angeles, Cal., has moved his office from the Hellman Building to 628½ Spring Street.

MR. CHARLES R. UNDERHILL has accepted a position as telephone and coil engineer with the American Electric Fuse Company, Muskegon, Mich.

MR. JOHN HAY KUHNS, who formerly practised as a consulting electrical engineer in Omaha and for several years has resided in Japan, has returned to this country for a short visit.

MR. HOWARD G. VERNON has moved his place of business from Claymont, Del., to 913 Orange Street, Wilmington, Del., where he will continue his work of engineering and contracting.

MR. A. N. BENTLEY has been appointed general manager of the Atlanta office of the Electric Storage Battery Company, having recently been transferred from the Cleveland office of the company.

PROF. WM. L. PUFFER has taken new offices in the Boston Safe Deposit & Trust Building, where he will continue to conduct a consulting and expert electrical engineer business in all of its branches.

MR. FREDERICK F. ESPENSCHIED, who was formerly with the West Penn Railroad Company, has become general manager of the Interstate Light & Power Company, with headquarters at Galena, Ill.

MR. C. H. BRISTOL, who for the past three years has been manager of the advertising department of the Electric Service Supplies Company, Philadelphia, Pa., has recently accepted a position with the Electric Storage Battery Company, where he will be associated in the advertising department of that company with Dr. C. H. Reed, the advertising manager.

MR. JOHN F. COLLINS has tendered his resignation as general manager and superintendent of the Saginaw & Bay City Railway & Light Company to become assistant manager of the Toledo Railways & Light Company, of Toledo, Ohio, of which company he was formerly superintendent. Mr. Collins will take up the duties of his new office on April 1.

LIEUT. E. ALEXIS JEUNET, U. S. A., one of the "wireless" experts of the Government, was a visitor at the Chicago Electrical Show last week. Lieutenant Jeunet has recently returned from Alaska where he was engaged in making a wireless-telegraph installation, and he was much interested in the experimental demonstration of "wireless" in connection with the Wright aeroplane at the show.

RICHARDSON & HALE.—Mr. Edward B. Richardson, formerly assistant engineer with Messrs. Hollis French and Allen Hubbard, consulting engineers, and Mr. Richard K. Hale, formerly assistant engineer with Mr. Robert Spurr Weston and Messrs. Metcalf & Eddy, have formed a partnership under the firm name of Richardson & Hale, consulting engineers, with offices at 85 Water Street, Boston, Mass.

MR. H. C. DONECKER, who has been office manager of the American Street and Interurban Railway Association, has been elected secretary of that organization to succeed Mr. B. V. Swenson, whose resignation was tendered some time ago. Mr. Donecker was formerly connected with the Lorain Steel Company, St. Louis Transit Company, and was also associated with Tom Johnson, of Cleveland, and with Giles S. Allison, of New York, for a time. Prior to coming with the American Street and Interurban Railway Association, Mr. Donecker was engaged in statistical work with Ford, Bacon & Davis.

MR. JOHN W. BLAISDELL, requisition and voucher clerk in the municipal Department of Electricity, Chicago, is seriously ill as the result of a stroke of paralysis, following other attacks of the same nature. Mr. Blaisdell, who is about 73 years of age, was a familiar figure at headquarters in Electricity Building at the Chicago World's Fair of 1893 under Mr. John P. Barrett, the chief of the department. Since then he has been connected with the city's electrical department under successive administrations. He is an old-time actor and was once leading man for Maggie Mitchell. He bears a strong resemblance to Mark Twain, and his urbane manners make him a great favorite with all who come in contact with him.

MR. ALTON S. MILLER, formerly vice-president and general manager of the Union Electric Light & Power Company, St. Louis, was chosen president and general manager of the company last week at the first meeting of the new board of directors chosen a few days previously.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

ENGINEERING SOCIETY OF WISCONSIN. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Mo. Next meeting, Milwaukee, Wis., Feb. 23, 24 and 25, 1910.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, C. H. Lembower, Reading, Pa.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Fred. Leslie, Muncie, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting Sioux City, April 20 and 21, 1910.

IOWA ELECTRICAL SHOW, Sioux City, Ia., April 20 to 24, 1910.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, Minneapolis, Minn., March 29, 30 and 31, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Scranton, Miss., June 15, 1910.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, May, 1910.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

NORTHWESTERN ELECTRICAL SHOW, Minneapolis, Minn., March 26—April 2, 1910. Secretary, C. D. Wilkinson, care Western Electric Co., Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow; Guthrie, Okla. Next meeting, Sapulpa, Okla., May, 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

SAN FRANCISCO ELECTRICAL SHOW, Jan. 29 to Feb. 5, 1910. E. M. Scribner, Chairman.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Lena M. Owen, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt. Next meeting, Montpelier, Vt., Sept. 14 and 15, 1910.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

JET CONDENSERS.—Some interesting departures of design are involved in a jet condenser which gives a vacuum of 28.75 in. of mercury, being so designed that a thorough mixture of exhaust steam and cooling water takes place, while the air present is prevented from pocketing and is delivered to the air pump at a minimum temperature. These features are brought out, and the general theory of jet-condenser construction discussed, in a reprint of the article, "A Radical Improvement in Jet Condensers," which is being distributed in booklet form by the Wheeler Condenser & Engineering Company, of Carteret, N. J.

DISPATCHER'S SIGNALS FOR ELECTRIC RAILWAYS.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued an illustrated bulletin describing its system of car dispatching for electric interurban railways. By this system it is possible for the dispatcher to signal any train or car at any siding by inserting a plug in the corresponding jack of his master-machine dial, raising the local semaphore and returning a record to the tape in the dispatcher's office. The car crew is then communicated with by telephone. Only a single iron line wire is required, providing both the signaling and report-back functions. The central-energy system is used.

BUSINESS NOTES.

SANBORN-MARSH ELECTRIC COMPANY.—Messrs. G. M. and A. W. Sanborn have acquired the interests of H. B. Marsh in the Sanborn-Marsh Electric Company, Indianapolis, Ind. Mr. Chas. L. Smith, formerly general superintendent, succeeds Mr. Marsh as secretary of the company.

WAVERLY ELECTRIC VEHICLES.—The Waverly Company, of Indianapolis, has recently received two orders from abroad for American-made electric vehicles. One was from J. E. Court, of the town of Cheribon, Island of Java, inclosing London exchange for the full value of a Waverly four-passenger brougham, the most expensive car built by the company. Lack of electric lighting or charging stations in Cheribon will make it necessary to ship with the car a gasoline charging plant. The second order is for a Waverly two-passenger coupé for the Barbour Co., in Lisburn, Ireland. The Waverly company has made recent sales of its electric vehicles in San Domingo and Honolulu.

FRINK'S REFLECTORS.—I. P. Frink, 551 Pearl Street, New York, is much gratified at the constantly increasing favor with which Frink's special cluster reflectors for tungsten or Mazda lamps are meeting throughout the country. Over 70 Frink special tungsten clusters have just been installed in the Chicago headquarters of Hart, Schaffner & Marx, and over 100 in the Fifth Avenue store of Franklin Simon & Co., New York City. Frink's special bronze reflectors for lighting the desks and screens of banks have recently been placed in the Old Colony Trust Company, Boston, Mass.; New England National Bank, Kansas City, Mo., and the Mechanics-American Bank, St. Louis, Mo.

THE MINERALLAC ELECTRIC COMPANY, Chicago, has moved its offices from 839-40 Monadnock Block, to its factory, 1004-6 West Van Buren Street, following the consolidation of the Chicago Electric Meter Company and the Minerallac Company under the new firm name Minerallac Electric Company. The company will shortly issue a bulletin on the new type of Chicago printing attachment which may be attached to any integrating wattmeter by the customer on his own premises, and which prints on a paper tape the actual amount of current consumed during any interval from 15 to 60 minutes. It also announces an increase in the sale of high-tension insulating compounds for use on underground work.

ARMALAC.—It is reported by the Massachusetts Chemical Co., Walpole, Mass., that the past year has marked an exceptional increase in the use of Armalac, particularly for the insulation of armatures. This appears to be the logical result of maintaining for nearly 20 years the same quality of product because it remains plastic under repeated heating and cooling, Armalac enables the coils to resist moisture even after years of service. Such plasticity results from the fact that this insulating compound is made upon a base of black paraffin wax, the melting point of which is raised permanently by a process known only to this company. This permanency of insulation distinguishes it from cheaper spirit varnishes which by drying out and crumbling lose what moisture-proof qualities they may have originally possessed.

THE SOUTHERN WESCO SUPPLY COMPANY, a Birmingham, Ala., organization, incorporated Jan. 1, this year, has taken over the business, good will and stock of the Birmingham branch of the Wesco Supply Company, St. Louis. The new organization is headed by some of the best known electrical men in that section of the country. Mr. Oscar C. Turner, formerly general sales manager of the Peerless Lamp Company, Warren, Ohio, is president of the new concern. The vice-president is Mr. Rogers V. Scudder, who is the executive head of the Wesco Supply Company, of St. Louis, and Mr. William M. Bowles, who for the past 10 years has been secretary of the Southern Electrical Company, of Nashville, is secretary and treasurer. The new company has already secured an order from the Fort Payne Fuel & Iron Company for a lighting plant at Fort Payne, Ala.

YALE & TOWNE OFFICE CHANGES.—Mr. F. A. Hall, who for the past 12 years has been manager of the chain block and hoist department of the Yale & Towne Manufacturing Company, the general offices of which are at 9-13 Murray Street, New York, and works at Stamford, Conn., has resigned his position in order to accept election as vice-president and treasurer of the Cameron Engineering Company, of Brooklyn, N. Y. Mr. Hall's successor will be Mr. R. T. Hodgkins, who for several years has been his chief assistant, and who is thoroughly qualified by experience and ability successfully to perform the duties of the position. In his new connection Mr. Hall expects to make a specialty of trolleys and appliances for overhead handling of materials, and in connection therewith, to make use of the Yale & Towne blocks and hoists, with the sale of which he has so long and prominently been identified.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., May 16-20, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo. Next meeting, Glenwood Springs, Sept. 14-17. July, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland anl Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.